CELLULAR

# SARA-U2 series

## 3.75G HSPA Cellular Modules

### Data Sheet


**Abstract**

Technical data sheet describing SARA-U2 series HSPA cellular modules.

These modules are a complete and cost efficient 3.75G solution offering 2-band high-speed HSPA and up to 2-band GSM/EGPRS voice and/or data transmission technology in a compact form factor.

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## This document applies to the following products:

| Product name | Type number | Modem version | Application version | PCN / IN |
|---|---|---|---|---|
| SARA-U260 | SARA-U260-00S-00 | 23.20 | A01.00 | UBX-14015739 |
| | SARA-U260-03S-00 | 23.41 | A01.01 | UBX-15020745 |
| SARA-U270 | SARA-U270-00S-00 | 23.20 | A01.00 | UBX-14015739 |
| | SARA-U270-03S-00 | 23.41 | A01.01 | UBX-15020745 |
| | SARA-U270-53S-00 | TBD | TBD | TBD |
| SARA-U270 ATEX | SARA-U270-00X-00 | 23.20 | A01.00 | TBD |
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# 1 Functional description

## 1.1 Overview

The SARA-U2 series modules are a 3.75G UMTS/HSPA solution in the miniature (26.0 x 16.0 mm) SARA LGA form factor that allows seamless drop-in migration from u-blox SARA-G3 series GSM/GPRS modules and easy migration to u-blox LISA-U series UMTS/HSPA+ modules, u-blox LISA-C2 series CDMA modules and to u-blox TOBY-L series LTE modules.

SARA-U2 modules feature HSPA data-rates of 7.2 Mb/s (downlink) and 5.76 Mb/s (uplink). The modules offer data and voice communication over an extended operating temperature range of –40 to +85 °C, with low power consumption and a rich feature set including dual-stack IPv4 / IPv6.

The SARA-U2 series includes variants supporting band combination for North America and band combination for Europe, Asia and other countries. For each combination, a complete UMTS/GSM variant and a cost-saving UMTS-only variant are available.

SARA-U2 modules are complete, fully qualified and certified solutions, which reduce costs and enable short time to market. They are ideally suited to M2M and automotive applications such as: mobile Internet terminals, car infotainment and telematics, Automatic Meter Reading (AMR), Remote Monitoring Automation and Control (RMAC), surveillance and security, road pricing, asset tracking, fleet management, anti theft systems, and Point of Sales (PoS) terminals.

SARA-U2 modules support full access to u-blox GNSS receivers via serial port. Thus any host processor connected to the cellular module through a single serial port can control both the cellular module and the positioning chip/module. The compact SARA 26.0 x 16.0 mm form factor with LGA pads (functionally, referred to as “pins”) allows fully automated assembly with standard pick & place and reflow soldering equipment for cost-efficient, high-volume production.

## 1.2 Product features

| Module | UMTS | | Bands | | Interfaces | | | | Audio | | Features | | | | | | | | | | | | | Grade | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | HSUPA [Mb/s] | HSDPA [Mb/s] | 3G bands [MHz] | 2G bands [MHz] | UART | USB 2.0 | DDC ($I^2C$) | GPIO | Analog Audio | Digital Audio | Network indication | Antenna supervisor | Jamming detection | Embedded TCP / UDP | Embedded HTTP, FTP | Embedded SSL / TLS | GNSS via Modem | AssistNow Software | CellLocate® | FW update via serial | eCall / ERA-GLONASS | Rx diversity | Dual stack IPv4/IPv6 | Standard | Professional | Automotive |
| **SARA-U260** | 5.76 | 7.2 | 850/1900 | 850/1900 | 1 | 1 | 1 | 9 | | 1 | • | • | • | • | • | • | • | • | • | • | | | • | | | |
| **SARA-U270** | 5.76 | 7.2 | 900/2100 | 900/1800 | 1 | 1 | 1 | 9 | | 1 | • | • | • | • | • | • | • | • | • | • | • | | • | | | |
| **SARA-U270 ATEX** | 5.76 | 7.2 | 900/2100 | 900/1800 | 1 | 1 | 1 | 9 | | 1 | • | • | • | • | • | • | • | • | • | • | • | | • | | | |
| **SARA-U280** | 5.76 | 7.2 | 850/1900 | | 1 | 1 | 1 | 9 | | 1 | • | • | • | • | • | • | • | • | • | • | | | • | | | |

SARA-U270-53S module product version is approved by KT Korean network operator

**Table 1: SARA-U2 series main features summary**[1]

[1] SARA-U270 ATEX modules provide the same feature set as the SARA-U270 modules, with the additional certification for use in potentially

## 1.3 Block diagram

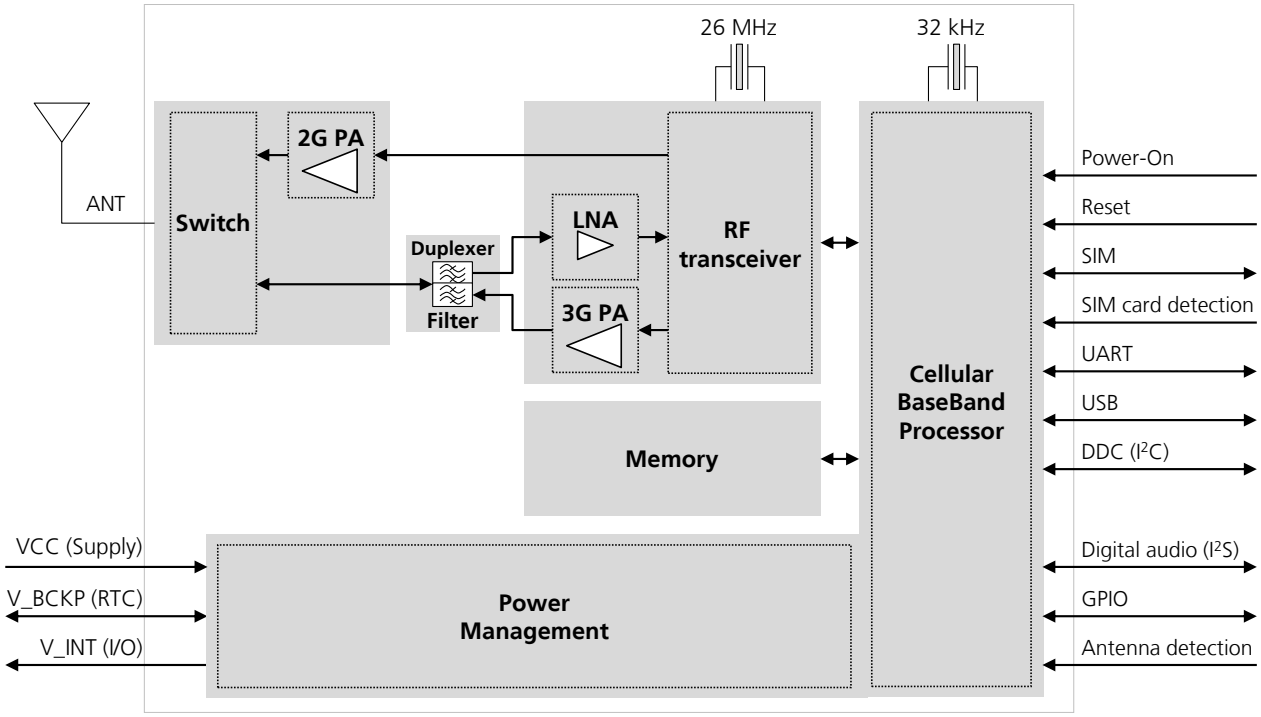


**Figure 1: SARA-U260 and SARA-U270 block diagram**

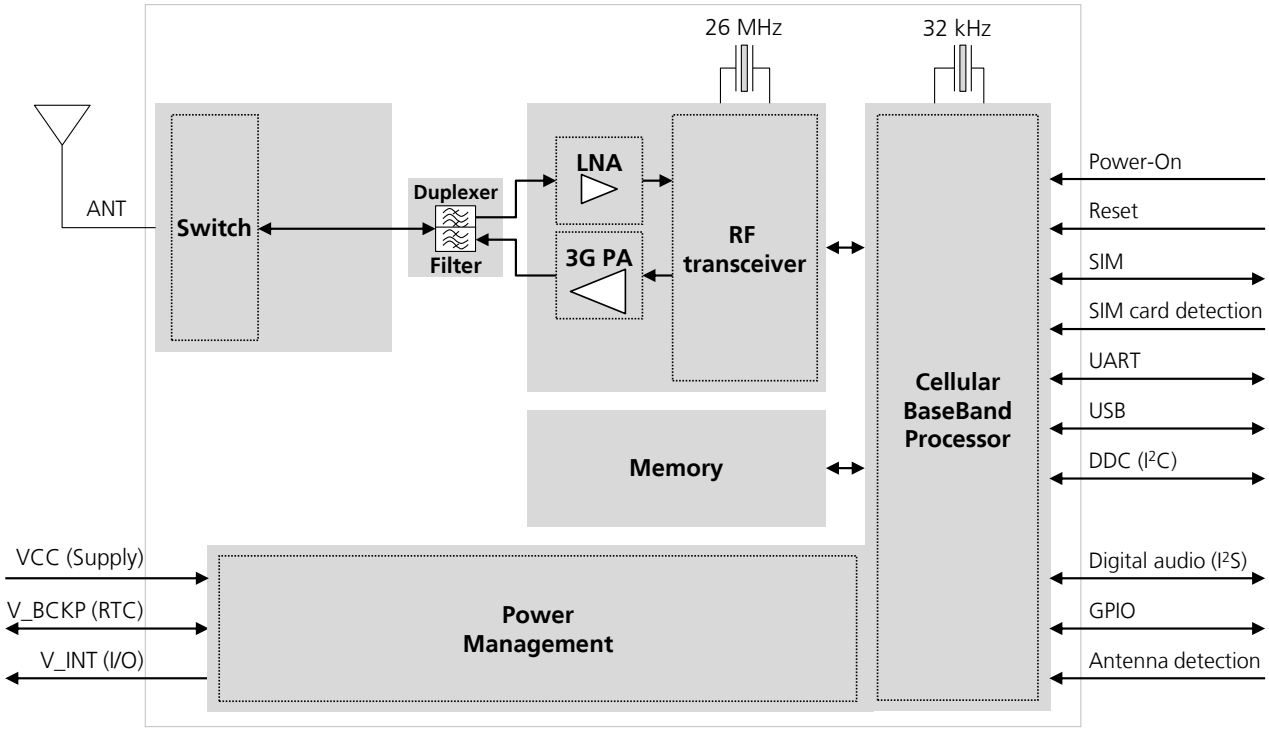


**Figure 2: SARA-U280 block diagram**

## 1.4 Product description

SARA-U2 series modules provide variants to support different band combinations for specific regions:

- SARA-U260 and SARA-U280 are mainly designed for operation in America
- SARA-U270 is mainly designed for operation in Europe, Asia and other countries

| 3G UMTS/HSDPA/HSUPA characteristics | 2G GSM/GPRS/EDGE characteristics[2] |
|---|---|
| Class A User Equipment[3] | Class B Mobile Station[4] |
| 3GPP Release 7<br>High Speed Packet Access (HSPA)<br>UMTS Terrestrial Radio Access (UTRA)<br>Frequency Division Duplex (FDD) | 3GPP Release 7<br>Enhanced Data rate GSM Evolution (EDGE)<br>GSM EGPRS Radio Access (GERA)<br>Time Division Multiple Access (TDMA) |
| Dual-band support:<br>• SARA-U260 and SARA-U280:<br>Band V (850 MHz)<br>Band II (1900 MHz)<br>• SARA-U270:<br>Band VIII (900 MHz)<br>Band I (2100 MHz) | Dual-band support:<br>• SARA-U260:<br>GSM 850 MHz<br>PCS 1900 MHz<br>• SARA-U270:<br>E-GSM 900 MHz<br>DCS 1800 MHz |
| WCDMA/HSDPA/HSUPA Power Class<br>• Power Class 3 (24 dBm) for WCDMA/HSDPA/HSUPA mode | GSM/GPRS/EDGE Power Class<br>• Power Class 4 (33 dBm) for GSM/E-GSM bands<br>• Power Class 1 (30 dBm) for DCS/PCS bands |
| PS (Packet Switched) data rate<br>• HSUPA category 6, up to 5.76 Mb/s UL<br>• HSDPA category 8, up to 7.2 Mb/s DL<br>• WCDMA PS data, up to 384 kb/s DL/UL | PS (Packet Switched) data rate[5]<br>• GPRS multi-slot class 12[6], CS1-CS4 up to 85.6 kb/s DL/UL<br>• EDGE multi-slot class 12[7], MCS1-MCS9 up to 236.8 kb/s DL, MCS1-MCS4 up to 70.4 kb/s UL |
| CS (Circuit Switched) data rate<br>• WCDMA CS data, up to 64 kb/s DL/UL | CS (Circuit Switched) data rate<br>• GSM CS data, up to 9.6 kb/s DL/UL<br>supported in transparent/non transparent mode |

**Table 2: SARA-U2 series 3G and 2G characteristics**

Operation modes I to III are supported on GSM/GPRS networks, with user-defined preferred service selectable from GSM to GPRS. Paging messages for GSM calls can be optionally monitored during GPRS data transfer in not-coordinating NOM II-III. Direct Link mode is supported for TCP and UDP sockets.

[2] Supported only by SARA-U260 and SARA-U270 modules
[3] Device can work simultaneously in Packet Switch and Circuit Switch mode: voice calls are possible while the data connection is active without any interruption in service.
[4] Device can be attached to both GPRS and GSM services (i.e. Packet Switch and Circuit Switch mode) using one service at a time. If for example during data transmission an incoming call occurs, the data connection is suspended to allow the voice communication. Once the voice call has terminated, the data service is resumed.
[5] GPRS / EDGE multi-slot class determines the number of timeslots available for upload and download and thus the speed at which data can be transmitted and received, with higher classes typically allowing faster data transfer rates.
[6] GPRS multi-slot class 12 implies a maximum of 4 slots in DL (reception) and 4 slots in UL (transmission) with 5 slots in total.
[7] EDGE multi-slot class 12 implies a maximum of 4 slots in DL (reception) and 4 slots in UL (transmission) with 5 slots in total.

| Basic features | Supplementary services | Short Message Service (SMS) |
|---|---|---|
| Display of Called Number | Call Hold/Resume (HOLD) | Text and PDU mode supported |
| Indication of Call Progress Signals | Call Waiting (CW) | Mobile-Originating SMS (MO SMS) |
| Country/PLMN Indication | Multi-Party (MTPY) | Mobile-Terminating SMS (MT SMS) |
| Country/PLMN Selection | Call Forwarding (CFU, CFB, CFNRy, CFNRc) | SMS indication and acknowledgement |
| International Access Function | Call Deflection (CD) | SMS Cell Broadcast (CBS) |
| Service Indicator | Explicit Call Transfer (ECT) | SMS during circuit-switched calls |
| Emergency Calls Capabilities | Call Barring (BAOC, BOIC, BOIC-exHC, BAIC, BIC_Roam) | SMS over CSD |
| Dual Tone Multi Frequency (DTMF) | Advice of Charge Charging (AoCC, AoCI) | SMS over PSD |
| Subscription Identity Management | Calling Line Identification Presentation (CLIP) | SMS storage on SIM |
| Service Provider Indication | Calling Line Identification Restriction (CLIR) | SMS storage on module memory |
| Abbreviated Dialing | Connected Line Identification Presentation (CoLP) | Concatenated SMS |
| Fixed Number Dialing | Connected Line Identification Restriction (CoLR) | |
| Barring of Dialed Numbers | Unstructured Supplementary Services Data (USSD) | |
| SIM Application Toolkit | Network Identify and Time Zone (NITZ) | |
| ME-SIM lock | Calling Name Presentation (CNAP) | |
| SIM Access Profile | | |

**Table 3: SARA-U2 series mobile stations: basic features, supplementary services and SMS service summary[8]**

## 1.5 AT command support

SARA-U2 series modules support AT commands according to the 3GPP Technical Specifications 27.007 [1], 27.005 [2], 27.010 [3], and the u-blox AT command extension.

☞ For the complete list of the supported AT commands and their syntax see the u-blox AT Commands Manual [4].

RIL (Radio Interface Layer) software for Android and Embedded Windows is available for SARA-U2 series modules free of charge; see the Android RIL Production delivery [5] and the Windows Embedded RIL Production delivery [6] application notes for more information.

[8] All these functionalities are supported via AT commands (for more details see u-blox AT Commands Manual [4]).

## 1.6 Supported features

Table 4 lists the main features supported by SARA-U2 modules. For more details see the SARA-G3 and SARA-U2 series System Integration Manual [7] and u-blox AT commands manual [4].

| Feature | Description |
|---|---|
| Network indication | GPIO configured to indicate the network status: registered home network, registered roaming, voice or data call enabled, no service.<br>The feature can be enabled through the +UGPIOC AT command. |
| Antenna detection | The **ANT_DET** pin provides antenna presence detection capability, evaluating the resistance from the **ANT** pin to GND by means of an external antenna detection circuit implemented on the application board.<br>The antenna detection feature can be enabled through the +UANTR AT command. |
| Jamming detection | Detects some "artificial" interference that obscures the operator's carriers entitled to give access to the GSM/UMTS service and reports the start and stop of such conditions to the application processor (AP). The AP can react appropriately by e.g. switching off the radio transceiver to reduce power consumption and monitoring the environment at constant periods.<br>The feature can be enabled and configured through the +UCD AT command. |
| Embedded TCP and UDP stack | Embedded TCP/IP and UDP/IP stack including direct link mode for TCP and UDP sockets.<br>Sockets can be set in Direct Link mode to establish a transparent end to end communication with an already connected TCP or UDP socket via serial interface. |
| FTP, FTPS | File Transfer Protocol as well as Secure File Transfer Protocol (SSL encryption of FTP control channel) functionalities are supported via AT commands. |
| HTTP, HTTPS | Hyper-Text Transfer Protocol as well as Secure Hyper-Text Transfer Protocol (SSL encryption) functionalities is supported via AT commands. HEAD, GET, POST, DELETE and PUT operations are available. Up to four client contexts can be simultaneously used. |
| Embedded TLS 1.2[10] | With the support of X.509 certificates, Embedded TLS 1.2 provides server and client authentication, data encryption, data signature and enables TCP/IP applications like HTTPS and FTPS to communicate over a secured and trusted connection.<br>The feature can be configured and enabled by +USECMNG and +USECPRF AT commands. |
| IPv4/IPv6 dual-stack | Capability to move between IPv4 and dual stack network infrastructures. IPv4 and IPv6 addresses can be used. |
| GNSS via modem | Full access to u-blox positioning chips and modules is available through a dedicated DDC ($I^2C$) interface. This means that from any host processor a single serial port can control the cellular module and the positioning chip or module. For more details see the GNSS Implementation Application Note [8]. |
| Embedded AssistNow Software | Embedded AssistNow Online and AssistNow Offline clients to provide better GNSS performance and faster Time-to-First-Fix. An AT command can enable / disable the clients. |
| CellLocate® | Enables the estimation of device position based on the parameters of the mobile network cells visible to the specific device based on the CellLocate® database:<br>• Normal scan: only the parameters of the visible home network cells are sent<br>• Deep scan: the parameters of all surrounding cells of all mobile operators are sent<br>CellLocate® is implemented using a set of AT commands that allow configuration and position request. |
| Hybrid Positioning | The module current position is provided using a u-blox positioning chip or module or the estimated position from CellLocate® depending by which positioning method provides the best and fastest solution according to the user configuration.<br>Hybrid positioning is implemented through a set of AT commands that allow configuration and position request. |
| Control Plan Aiding / LCS[10] | Assisted GPS Location Services feature, which is based on the Radio Resources Location Protocol (RRLP), according to 3GPP TS 44.031 [10], and Radio Resource Control (RRC), according to 3GPP TS 25.331 [18]. With the Assisted GPS feature, a location server provides the module with the GPS system information that otherwise must be downloaded from satellites. The feature allows faster position fixes, increases sensitivity and reduces module power consumption. The feature is invoked by the module through LCS Supplementary Services or by the Network during emergency calls. |
| Firmware update Over AT commands (FOAT) | Firmware module upgrade over UART and USB interface using AT command.<br>The firmware upgrade can be executed through the +UFWUPD AT command. |

| Feature | Description |
|---|---|
| Smart Temperature Supervisor | Constant monitoring of the module board temperature:<br>• Warning notification when the temperature approaches an upper or lower predefined threshold<br>• Shutdown notified and forced when the temperature value is outside the specified range (shutdown suspended in case of an emergency call in progress)<br>The feature can be enabled or disabled through the +USTS AT command.<br>☞ The sensor measures board temperature, which can differ from ambient temperature. |
| SIM Access Profile (SAP) | Allows access and use of a remote (U)SIM card instead of the local SIM card directly connected to the module (U)SIM interface. The module acts as an SAP Client establishing a connection and performing data exchange to a SAP Server directly connected to the remote SIM.<br>The modules provide a dedicated USB SAP channel and a dedicated multiplexer SAP channel over UART for communication with the remote (U)SIM card.<br>The feature can be configured and enabled by +USAPMODE and + USAPIND AT commands. |
| BIP[10] | Bearer Independent Protocol for Over-the-Air SIM provisioning. The data transfer to/from the SIM uses either an already active PDP context or a new PDP context established with the APN provided by the SIM card. |
| In-Band Modem[9] | In-Band modem solution for eCall and ERA-GLONASS emergency call applications over cellular networks implemented according to the 3GPP TS 26.267 specification [9].<br>When activated, the in-vehicle eCall / ERA-GLONASS system (IVS) creates an emergency call carrying both voice and data (including vehicle position data) directly to the nearest Public Safety Answering Point (PSAP) to determine whether rescue services should be dispatched to the known position. |
| DTMF decoder | During a voice call, the Dual-Tone Multi-Frequency detector analyses the RX speech (coming from the remote party). The detected DTMF symbols can be output via the related URC.<br>For more details, see the +UDTMFD AT command. |
| Power saving | The power saving configuration is by default disabled, but it can be configured using an AT command. When power saving is enabled, the module automatically enters the low power idle-mode whenever possible, reducing current consumption. During idle-mode, the module processor core runs with the RTC 32 kHz reference clock, which is generated by the internal 32 kHz oscillator<br>The feature can be enabled through the +UPSV AT command. |
| Automatic selection of authentication type[10] | Automatic selection of authentication type during PDP context activation. The module will sequentially try different authentication protocols (none/CHAP/PAP) until the authentication succeeds.<br>The feature can be enabled through the +UPSD and +UAUTHREQ AT commands. |
| Signal quality report for Packet Switched calls[10] | The quality of the GPRS UL and/or DL connection is returned by the AT+CSQ command. |
| eMLPP[10] | Multi-Level Precedence and Pre-emption Service (eMLPP) permits to handle the call priority. The maximum priority associated to a user is set in the SIM: within this threshold, the user can assign different priorities to the calls. This results in a differentiated treatment of the calls by the network in case of abnormal events such as handovers to congested cells.<br>The feature can be enabled through the +CAEMLPP, +CPPS, +CAAP AT commands. |
| Network Friendly Mode[10] | When the Network Friendly Mode is enabled, the module reacts to service request denials by using time-spaced, randomized or delayed retry schemes according to GSMA IoT Device Connection Efficiency Guidelines [19].<br>The feature can be enabled through the +UNFM, +UNFMCONF and +URPM AT commands. |
| Ethernet (CDC-ECM) over USB interface[10] | Ethernet (CDC-ECM) interface allowing networking from a HOST by means of the IP address received from the cellular network (bridge mode).<br>The HOST configuration is performed via the DHCP protocol (a DHCP server is implemented).<br>It operates as a not exclusive alternative to PPP dial-up.<br>The feature can be configured by +UUSBCONF and enabled by +UCEDATA AT commands. |

**Table 4: Main supported features of the SARA-U2 series**

☞ u-blox is extremely mindful of user privacy. When a position is sent to the CellLocate® server, u-blox is unable to track the SIM or the specific device that sent the position.

[9] Supported only by SARA-U270 modules
[10] Not supported by "00" product version

# 2 Interfaces

## 2.1 Power management

### 2.1.1 Module supply (VCC)

SARA-U2 modules must be supplied through the **VCC** pins by a DC power supply. Voltages must be stable: during operation, the current drawn from **VCC** can vary by some order of magnitude, especially due to the surging consumption profile of the GSM system (described in SARA-G3 and SARA-U2 series System Integration Manual [7]). It is important that the system power supply circuit is able to support peak power.

### 2.1.2 RTC supply (V_BCKP)

**V_BCKP** is the Real Time Clock (RTC) supply of SARA-U2 modules. When **VCC** voltage is within the valid operating range, the internal Power Management Unit (PMU) supplies the RTC and the same supply voltage is available on **V_BCKP** pin. If the **VCC** voltage is under the minimum operating limit (e.g. during not powered mode), the **V_BCKP** pin can externally supply the RTC.

### 2.1.3 Generic digital interfaces supply (V_INT)

SARA-U2 modules provide a 1.8 V supply rail output on the **V_INT** pin, which is internally generated when the module is switched on. The same voltage domain is used internally to supply the generic digital interfaces of the modules. The **V_INT** supply output can be used in place of an external discrete regulator optimizing the bill of material for various applications, e.g. with u-blox GNSS receivers operating at 1.8 V.

## 2.2 Antenna

### 2.2.1 Antenna RF interface (ANT)

The **ANT** pin has an impedance of 50 Ω and provides the RF antenna interface of SARA-U2 modules.

### 2.2.2 Antenna detection (ANT_DET)

The **ANT_DET** pin is an Analog to Digital Converter (ADC) input to sense the antenna presence (as optional feature), evaluating the resistance from the **ANT** pin to GND by means of an external antenna detection circuit implemented on the application board (for more details see the SARA-G3 and SARA-U2 series System Integration Manual [7] and the u-blox AT Commands Manual [4], +UANTR).

## 2.3 System functions

### 2.3.1 Module power-on

SARA-U2 modules can be switched on in one of the following ways:

- Rising edge on **VCC** pins to a valid voltage for module supply, i.e. applying module supply
- Low pulse on **PWR_ON** pin, i.e. forcing the pin (normally high with external pull-up) to a low level for a valid time period (see section 4.2.6): **PWR_ON** pin requires an external pull-up resistor to set its value to logic high and may not be left floating
- Rising edge on **RESET_N** pin, i.e. releasing the pin from the low level, normally high with internal pull-up
- RTC alarm, i.e. pre-programmed scheduled time by AT+CALA command

### 2.3.2 Module power-off

SARA-U2 modules can be properly switched off, with storage of current parameter settings and network detach, in one of these ways:

- AT+CPWROFF command
- Low pulse on the **PWR_ON** pin for at least 1 s

An abrupt under-voltage shutdown occurs on SARA-U2 modules when the **VCC** supply drops below the extended operating range minimum limit, but in this case it is not possible to perform the storing of the current parameter settings in the module's non-volatile memory as well as the proper network detach.

An over-temperature or an under-temperature shutdown occurs on SARA-U2 modules when the temperature measured within the cellular module reaches the dangerous area, if the optional Smart Temperature Supervisor feature is enabled and configured by the dedicated AT command. For more details see the SARA-G3 and SARA-U2 series System Integration Manual [7] and u-blox AT commands manual [4], +USTS AT command.

### 2.3.3 Module reset

SARA-U2 modules can be properly reset (rebooted), with storage of current parameter settings and network detach, in this way:

- By the AT+CFUN command (see the u-blox AT Commands Manual [4]). This causes an "internal" or "software" reset of the baseband processor, excluding the integrated power management unit and the RTC internal block: the **V_INT** generic digital interfaces supply is enabled and each digital pin is set to its internal reset state (reported in Table 6), the **V_BCKP** supply and the RTC block are enabled.

An abrupt "external" or "hardware" reset occurs when a low level is applied to the **RESET_N** pin, which is normally set high by an internal pull-up, for a valid time period (see section 4.2.7). This causes a reset of the entire module, including the integrated power management unit, except for the RTC internal block: the **V_INT** generic digital interfaces supply is switched off and all the digital pins are tri-stated, but the **V_BCKP** supply and the RTC block are enabled. The current parameter settings are not saved in the module's non-volatile memory and a proper network detach is not performed.

## 2.4 SIM

### 2.4.1 (U)SIM interface

SARA-U2 modules provide a (U)SIM interface on the **VSIM**, **SIM_IO**, **SIM_CLK**, **SIM_RST** pins: the high-speed SIM/ME interface is implemented as well as automatic detection of the required SIM supporting voltage.

Both 1.8 V and 3 V SIM card/chip types are supported (1.8 V and 3 V ME). Activation and deactivation with automatic voltage switch from 1.8 V to 3 V is implemented, according to ISO-IEC 7816-3 specifications. The SIM driver supports the PPS (Protocol and Parameter Selection) procedure for baud-rate selection, according to the values proposed by the SIM card/chip.

### 2.4.2 SIM card detection (SIM_DET)

The **SIM_DET** pin of SARA-U2 modules is a 1.8 V digital input which is by default configured as an external interrupt to detect the SIM card presence (as a feature which can be optionally used) when it is properly connected to the mechanical switch of the SIM card holder (for more details see SARA-G3 and SARA-U2 series System Integration Manual [7]).

The **SIM_DET** pin of SARA-U2 modules can additionally be configured via AT command to provide the "SIM card hot insertion/removal" function (for more details see u-blox AT Commands Manual [4], +UDCONF=50).

The **SIM_DET** pin of SARA-U2 modules can additionally be configured via AT command as GPIO (for more details see section 2.7 and the u-blox AT Commands Manual [4], +UGPIOC, +UGPIOR, +UGPIOW).

## 2.5 Serial interfaces

SARA-U2 modules provide the following serial communication interfaces:

- UART interface: asynchronous serial interface available for AT commands, data communication, FW upgrade by means of the FOAT feature, FW upgrade by means of the u-blox EasyFlash tool
- USB interface: High-Speed USB 2.0 compliant interface available for AT commands, data communication, FW upgrade by means of the FOAT feature, FW upgrade by means of the u-blox EasyFlash tool and for diagnostic purpose
- DDC interface: $I^2C$ compatible interface available for the communication with u-blox GNSS positioning chips/modules and with external $I^2C$ devices as an audio codec

### 2.5.1 Asynchronous serial interface (UART)

The UART interface is a 9-wire 1.8 V unbalanced asynchronous serial interface provided for AT commands, data communication, FW upgrade by means of the FOAT feature, FW upgrade by means of the u-blox EasyFlash tool.

The UART features are:

- Complete serial port with RS-232 functionality conforming to the ITU-T V.24 Recommendation [11], with CMOS compatible signal levels (0 V for low data bit or ON state and 1.8 V for high data bit or OFF state)
- Data lines (**RxD** as output, **TxD** as input), hardware flow control lines (**CTS** as output, **RTS** as input), modem status and control lines (**DTR** as input, **DSR** as output, **DCD** as output, **RI** as output) are provided
- Hardware flow control (default value), software flow control, or none flow control are supported
- Power saving indication available[11] on the hardware flow control output (CTS line): the line is driven to the OFF state when the module is not prepared to accept data by the UART interface
- 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200, 230400, 460800 and 921600 b/s baud rates are supported for the AT interface
- Autobauding is by default enabled
- Frame format can be:
  - 8N2 (8 data bits, no parity, 2 stop bits)
  - 8N1 (8 data bits, no parity, 1 stop bit)
  - 8E1 (8 data bits, even parity, 1 stop bit)
  - 8O1 (8 data bits, odd parity, 1 stop bit)
  - 7E1 (7 data bits, even parity, 1 stop bit)
  - 7O1 (7 data bits, odd parity, 1 stop bit)
- Default frame configuration is 8N1

The UART serial interface can be conveniently configured through AT commands. For more details see the u-blox AT Commands Manual [4] (+IPR, +ICF, +IFC, &K, \Q, +UPSV AT command) and SARA-G3 and SARA-U2 series System Integration Manual [7].

[11] If enabled

#### 2.5.1.1 Autobauding feature

Only one shot autobauding is supported: the baud rate detection is performed only once, at module start up.

After detection the module works at the fixed baud rate (the detected one) and the baud rate can only be changed via the appropriate AT command (+IPR, for more details see the u-blox AT Commands Manual [4]).

- The module detects the followings baud rates (b/s): 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200, 230400
- The only detectable frame configurations are: 7E1, 7O1, 8N1, 8E1, 8O1

#### 2.5.1.2 Multiplexer protocol

SARA-U2 module has a software layer with MUX functionality, 3GPP TS 27.010 Multiplexer Protocol [3], available on the UART interface.

☞ The multiplexer protocol is supported over the UART physical interface only.

This is a data link protocol (layer 2 of OSI model) which uses HDLC-like framing and operates between the cellular module (Data Circuit-terminating Equipment) and the application processor (Data Terminal Equipment) allowing simultaneous sessions over the UART physical link: the user can concurrently use AT command interface on one MUX channel and Data communication on another MUX channel. Each session consists of a stream of bytes transferring various kinds of data such as SMS, CBS, PSD, GNSS, AT commands in general.

SARA-U2 modules provide the following virtual channels:

- Channel 0: control channel
- Channel 1 – 5: AT commands / data connection
- Channel 6: GNSS tunneling
- Channel 7: SAP (SIM Access Profile)

For more details see the Mux Implementation Application Note [12].

### 2.5.2 Universal Serial Bus (USB)

SARA-U2 series modules include a high-speed USB 2.0 compliant interface with maximum 480 Mb/s data rate. The module itself acts as a USB device and can be connected to any USB host.

The USB is the suitable interface for transferring high speed data between SARA-U2 series and a host processor, available for AT commands, data communication, FW upgrade by means of the FOAT feature, FW upgrade by means of the u-blox EasyFlash tool and for diagnostic purpose.

The **USB_D+** / **USB_D-** lines carry the USB serial data and signaling. The USB interface is automatically enabled by an external valid USB VBUS supply voltage (5.0 V typical) applied on the **VUSB_DET** pin.

SARA-U2 series modules can provide the following functions over the USB interface:

- CDC-ACM for AT commands and data communication
- CDC-ACM for GNSS tunneling
- CDC-ACM for diagnostic
- CDC-ACM for SAP (SIM Access Profile)
- CDC-ECM for Ethernet-over-USB

☞ CDC-ECM for Ethernet-over-USB function is not supported by the "00" product version.

The default configuration of the USB interface provides 7 USB CDC-ACM modem COM ports:

- USB1: AT and data
- USB2: AT and data
- USB3: AT and data
- USB4: GNSS tunneling
- USB5: Primary Log (diagnostic purpose)
- USB6: Secondary Log (diagnostic purpose)
- USB7: SAP (SIM Access Profile)

The user can concurrently use the AT command interface on one CDC, and Packet-Switched / Circuit-Switched Data communication on another CDC.

The USB interface can be configured by the AT+UUSBCONF command to provide a different set of functions, including 1 CDC-ECM for Ethernet-over-USB and 4 CDC-ACM modem COM ports enumerated as follows:

- USB1: AT and data
- USB2: GNSS tunneling
- USB3: Primary Log (diagnostic purpose)
- USB4: SAP (SIM Access Profile)

☞ The default profile of the USB interface cannot be changed on the "00" product version.

For more details regarding the USB configurations and capabilities, see the SARA-G3 and SARA-U2 series System Integration Manual [7] and the u-blox AT Commands Manual [4] (+UUSBCONF AT command).

USB drivers are available for the following operating system platforms:

- Windows XP
- Windows Vista
- Windows 7
- Windows 8
- Windows 8.1
- Windows CE 5.0
- Windows Embedded CE 6.0
- Windows Embedded Compact 7
- Windows Embedded Automotive 7
- Windows Mobile 5
- Windows Mobile 6
- Windows Mobile 6.1
- Windows Mobile 6.5

SARA-U2 modules are compatible with standard Linux/Android USB kernel drivers.

### 2.5.3 DDC ($I^2C$) bus interface

SARA-U2 modules include an $I^2C$ compatible DDC interface (**SDA**, **SCL**) available to communicate with a u-blox GNSS receiver and with external $I^2C$ devices as an audio codec: SARA-U2 module acts as an $I^2C$ master which can communicate with $I^2C$ slaves in accordance to the $I^2C$ bus specifications [13].

## 2.6 Audio

SARA-U2 modules have one 4-wire I²S digital audio interface (**I2S_CLK**, **I2S_RXD**, **I2S_TXD** and **I2S_WA**) that can be configured by AT commands in PCM or in normal I²S mode. (For more details see the u-blox AT Commands Manual [4] and the SARA-G3 and SARA-U2 series System Integration Manual [7].)

SARA-U2 modules provide a digital clock output (**CODEC_CLK**) for an external audio codec.

## 2.7 GPIO

SARA-U2 modules provide nine pins (**GPIO1**, **GPIO2**, **GPIO3**, **GPIO4**, **I2S_RXD**, **I2S_TXD**, **I2S_CLK**, **I2S_WA**, **SIM_DET**) which can be configured as general purpose input/output, or to provide the custom functions listed in Table 5 via u-blox AT commands. For further details see the SARA-G3 and SARA-U2 series System Integration Manual [7] and the u-blox AT Commands Manual [4], +UGPIOC, +UGPIOR, +UGPIOW, +UGPS, +UGPRF, +USPM, +UDCONF=50 commands.

| Function | Description | Module | Default GPIO | Configurable GPIOs |
|---|---|---|---|---|
| GSM Tx-burst indication | GSM transmit slot indication | SARA-U260, SARA-U270 | -- | GPIO1 |
| GNSS supply enable | Enable/disable the supply of the u-blox GNSS receiver connected to the cellular module | All | GPIO2 | GPIO1, GPIO2, GPIO3, GPIO4, SIM_DET |
| GNSS data ready | Sense when the u-blox GNSS receiver connected to the cellular module is ready for sending data over the DDC (I²C) interface | All | GPIO3 | GPIO3 |
| GNSS RTC sharing | RTC synchronization signal to the u-blox GNSS receiver connected to the cellular module | All | GPIO4 | GPIO4 |
| SIM card detection | SIM card physical presence detection | All | SIM_DET | SIM_DET |
| SIM card hot insertion | SIM card hot insertion/removal | All | -- | SIM_DET |
| Network status indication | Network status: registered 2G / 3G home network, registered 2G / 3G roaming, 2G / 3G data transmission, no service | All | -- | GPIO1, GPIO2, GPIO3, GPIO4, SIM_DET |
| Module status indication | Module status: power off mode, i.e. module switched off, versus idle, active or connected mode, i.e. module switched on | All | -- | GPIO1 |
| Module operating mode indication | Module operating mode: idle mode versus active or connected mode | All | -- | SIM_DET |
| I²S digital audio interface | I²S digital audio interface (**I2S_RXD**, **I2S_TXD**, **I2S_CLK**, **I2S_WA** respectively) | All | I2S_RXD, I2S_TXD, I2S_CLK, I2S_WA | I2S_RXD, I2S_TXD, I2S_CLK, I2S_WA |
| General purpose input | Input to sense high or low digital level | All | -- | All |
| General purpose output | Output to set the high or the low digital level | All | -- | All |
| Pin disabled | Tri-state with an internal active pull-down enabled | All | GPIO1 | All |

**Table 5: GPIO custom functions configuration**

# 3 Pin definition

## 3.1 Pin assignment

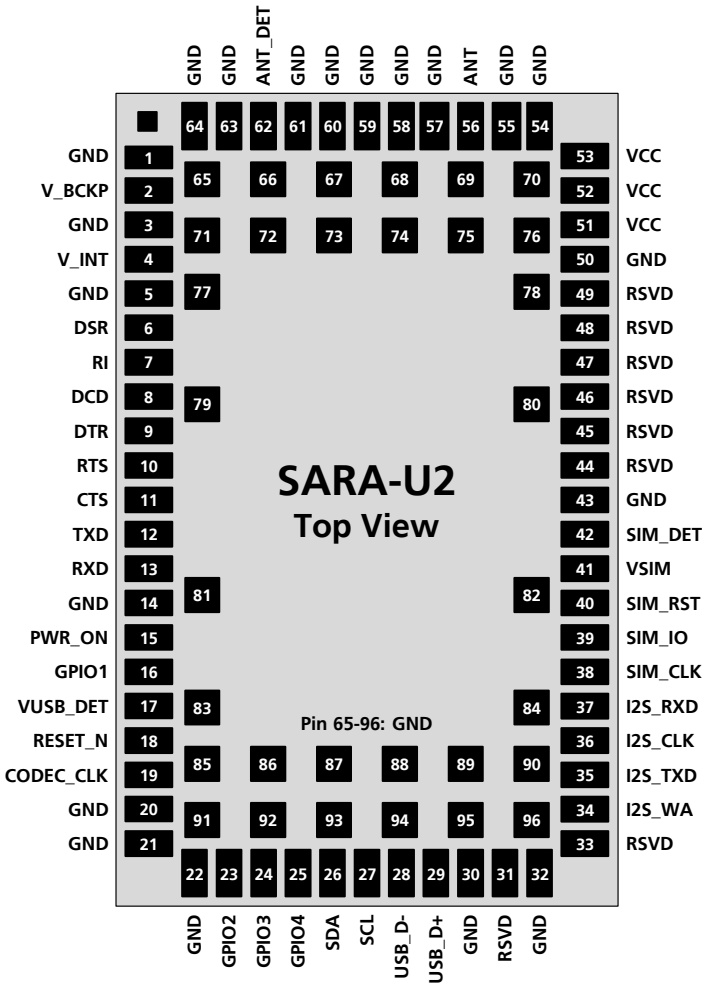


**Figure 3: SARA-U2 series pin assignment**

| No | Module | Name | Power domain | I/O | Description | Remarks |
|---|---|---|---|---|---|---|
| 1 | All | GND | - | N/A | Ground | All the GND pins must be connected to ground |
| 2 | All | V_BCKP | - | I/O | Real Time Clock supply input/output | V_BCKP = 1.8 V (typical) generated by the module to supply the Real Time Clock when VCC supply voltage is within valid operating range.<br>See section 4.2.2 for detailed electrical specs. |
| 3 | All | GND | - | N/A | Ground | All the GND pins must be connected to ground |
| 4 | All | V_INT | - | O | Generic Digital Interfaces supply output | V_INT = 1.8 V (typical) generated by the module when it is switched-on and the RESET_N (external reset input pin) is not forced to the low level.<br>See section 4.2.2 for detailed electrical specs. |
| 5 | All | GND | - | N/A | Ground | All the GND pins must be connected to ground |
| 6 | All | DSR | GDI | O | UART data set ready | Circuit 107 (DSR) in ITU-T V.24.<br>Output driver class D.<br>PU/PD class a. Value at internal reset: T/PU.<br>See section 4.2.9 for detailed electrical specs. |
| 7 | All | RI | GDI | O | UART ring indicator | Circuit 125 (RI) in ITU-T V.24.<br>Output driver class C_0.<br>PU/PD class c. Value at internal reset: T/PD.<br>See section 4.2.9 for detailed electrical specs. |
| 8 | All | DCD | GDI | O | UART data carrier detect | Circuit 109 (DCD) in ITU-T V.24.<br>Output driver class C_0.<br>PU/PD class c. Value at internal reset: T/PD.<br>See section 4.2.9 for detailed electrical specs. |
| 9 | All | DTR | GDI | I | UART data terminal ready | Circuit 108/2 (DTR) in ITU-T V. 24.<br>Internal active pull-up to V_INT enabled.<br>PU/PD class c. Value at internal reset: T/PD.<br>See section 4.2.9 for detailed electrical specs. |
| 10 | All | RTS | GDI | I | UART ready to send | Circuit 105 (RTS) in ITU-T V.24.<br>Internal active pull-up to V_INT enabled.<br>PU/PD class a. Value at internal reset: T/PU.<br>See section 4.2.9 for detailed electrical specs. |
| 11 | All | CTS | GDI | O | UART clear to send | Circuit 106 (CTS) in ITU-T V.24.<br>Output driver class A.<br>PU/PD class a. Value at internal reset: T/PU.<br>See section 4.2.9 for detailed electrical specs. |
| 12 | All | TXD | GDI | I | UART data input | Circuit 103 (TxD) in ITU-T V.24.<br>Internal active pull-up to V_INT enabled.<br>PU/PD class a. Value at internal reset: T/PD.<br>See section 4.2.9 for detailed electrical specs. |
| 13 | All | RXD | GDI | O | UART data output | Circuit 104 (RxD) in ITU-T V.24.<br>Output driver class A.<br>PU/PD class a. Value at internal reset: T/PU.<br>See section 4.2.9 for detailed electrical specs. |
| 14 | All | GND | - | N/A | Ground | All the GND pins must be connected to ground |
| 15 | All | PWR_ON | POS | I | Power-on input | The PWR_ON pin has high input impedance: don't leave it floating in noisy environment (an external pull-up resistor is required)<br>See section 4.2.6 for detailed electrical specs. |
| 16 | All | GPIO1 | GDI | I/O | GPIO | GPIO configurable as described in Table 5.<br>Output driver class A.<br>PU/PD class a. Value at internal reset: T/PD.<br>See section 4.2.9 for detailed electrical specs. |
| 17 | All | VUSB_DET | USB | I | USB detect input | Input for VBUS (5 V typical) USB supply sense.<br>See section 4.2.10 for detailed electrical specs. |
| 18 | All | RESET_N | ERS | I | External reset input | Internal 10 kΩ pull-up resistor to V_BCKP.<br>See section 4.2.7 for detailed electrical specs. |

| No | Module | Name | Power domain | I/O | Description | Remarks |
|---|---|---|---|---|---|---|
| 19 | All | CODEC_CLK | GDI | O | Clock output | Output driver class B.<br>PU/PD class b. Value at internal reset: T/PD.<br>See section 4.2.9 for detailed electrical specs. |
| 20 | All | GND | - | N/A | Ground | All the GND pins must be connected to ground |
| 21 | All | GND | - | N/A | Ground | All the GND pins must be connected to ground |
| 22 | All | GND | - | N/A | Ground | All the GND pins must be connected to ground |
| 23 | All | GPIO2 | GDI | I/O | GPIO | GPIO configurable as described in Table 5.<br>Output driver class A.<br>PU/PD class a. Value at internal reset: T/PD.<br>See section 4.2.9 for detailed electrical specs. |
| 24 | All | GPIO3 | GDI | I/O | GPIO | GPIO configurable as described in Table 5.<br>Output driver class A.<br>PU/PD class a. Value at internal reset: T/PD.<br>See section 4.2.9 for detailed electrical specs. |
| 25 | All | GPIO4 | GDI | I/O | GPIO | GPIO configurable as described in Table 5.<br>Output driver class A.<br>PU/PD class a. Value at internal reset: T/PD.<br>See section 4.2.9 for detailed electrical specs. |
| 26 | All | SDA | DDC | I/O | $I^2C$ bus data line | Fixed open drain. No internal pull-up.<br>Value at internal reset: T.<br>See section 4.2.11 for detailed electrical specs. |
| 27 | All | SCL | DDC | O | $I^2C$ bus clock line | Fixed open drain. No internal pull-up.<br>Value at internal reset: T.<br>See section 4.2.11 for detailed electrical specs. |
| 28 | All | USB_D- | USB | I/O | USB Data Line D- | 90 Ω nominal differential impedance.<br>Pull-up, pull-down and series resistors as required by USB 2.0 specifications [16] are part of the USB pin driver and need not be provided externally.<br>Value at internal reset: T.<br>See section 4.2.10 for detailed electrical specs. |
| 29 | All | USB_D+ | USB | I/O | USB Data Line D+ | 90 Ω nominal differential impedance.<br>Pull-up, pull-down and series resistors as required by USB 2.0 specifications [16] are part of the USB pin driver and need not be provided externally.<br>Value at internal reset: T.<br>See section 4.2.10 for detailed electrical specs. |
| 30 | All | GND | - | N/A | Ground | All the GND pins must be connected to ground |
| 31 | All | RSVD | - | N/A | RESERVED pin | Leave unconnected. |
| 32 | All | GND | - | N/A | Ground | All the GND pins must be connected to ground |
| 33 | All | RSVD | - | N/A | RESERVED pin | This pin must be connected to GND. |
| 34 | All | I2S_WA | GDI | I/O / I/O | $I^2S$ word alignment / GPIO | Configurable as $I^2S$ word alignment (Input with internal active pull-down enabled in slave mode, Output in master mode), or as GPIO (see Table 5).<br>Output driver class C.<br>PU/PD class a. Value at internal reset: T/PD.<br>See section 4.2.9 for detailed electrical specs. |
| 35 | All | I2S_TXD | GDI | O / I/O | $I^2S$ transmit data / GPIO | Configurable as $I^2S$ transmit data output, or as GPIO (see Table 5).<br>Output driver class C.<br>PU/PD class a. Value at internal reset: T/PD.<br>See section 4.2.9 for detailed electrical specs. |
| 36 | All | I2S_CLK | GDI | I/O / I/O | $I^2S$ clock / GPIO | Configurable as $I^2S$ clock (Input with internal active pull-down to GND enabled in slave mode, Output in master mode), or as GPIO (see Table 5).<br>Output driver class C.<br>PU/PD class a. Value at internal reset: T/PD.<br>See section 4.2.9 for detailed electrical specs. |

| No | Module | Name | Power domain | I/O | Description | Remarks |
|---|---|---|---|---|---|---|
| 37 | All | I2S_RXD | GDI | I / I/O | I²S receive data / GPIO | Configurable as I²S receive data input (with internal active pull-down enabled), or as GPIO (see Table 5).<br>Output driver class C.<br>PU/PD class a. Value at internal reset: T/PD.<br>See section 4.2.9 for detailed electrical specs. |
| 38 | All | SIM_CLK | SIM | O | SIM clock | Value at internal reset: L.<br>See section 4.2.8 for detailed electrical specs. |
| 39 | All | SIM_IO | SIM | I/O | SIM data | Internal 4.7 kΩ pull-up resistor to VSIM.<br>Value at internal reset: L/PD.<br>See section 4.2.8 for detailed electrical specs. |
| 40 | All | SIM_RST | SIM | O | SIM reset | Value at internal reset: L.<br>See section 4.2.8 for detailed electrical specs. |
| 41 | All | VSIM | - | O | SIM supply output | VSIM = 1.80 V typical or 2.90 V typical generated by the module according to the SIM card type.<br>See section 4.2.2 for detailed electrical specs. |
| 42 | All | SIM_DET | GDI | I | SIM detection | Configurable for the SIM card presence detection function, or as GPIO (see Table 5).<br>PU/PD class a. Value at internal reset: T/PD.<br>See section 4.2.9 for detailed electrical specs. |
| 43 | All | GND | - | N/A | Ground | All the GND pins must be connected to ground |
| 44 | All | RSVD | - | N/A | RESERVED pin | Leave unconnected. |
| 45 | All | RSVD | - | N/A | RESERVED pin | Leave unconnected. |
| 46 | All | RSVD | - | N/A | RESERVED pin | Leave unconnected. |
| 47 | All | RSVD | - | N/A | RESERVED pin | Leave unconnected. |
| 48 | All | RSVD | - | N/A | RESERVED pin | Leave unconnected. |
| 49 | All | RSVD | - | N/A | RESERVED pin | Leave unconnected. |
| 50 | All | GND | - | N/A | Ground | All the GND pins must be connected to ground |
| 51 | All | VCC | - | I | Module supply input | All VCC pins must be connected to external supply.<br>See sections 4.2.2 and 4.2.3 for detailed specs. |
| 52 | All | VCC | - | I | Module supply input | All VCC pins must be connected to external supply.<br>See sections 4.2.2 and 4.2.3 for detailed specs. |
| 53 | All | VCC | - | I | Module supply input | All VCC pins must be connected to external supply.<br>See sections 4.2.2 and 4.2.3 for detailed specs. |
| 54 | All | GND | - | N/A | Ground | All the GND pins must be connected to ground |
| 55 | All | GND | - | N/A | Ground | All the GND pins must be connected to ground |
| 56 | All | ANT | - | I/O | RF input/output | 50 Ω nominal impedance<br>See section 4.2.4 for detailed electrical specs. |
| 57 | All | GND | - | N/A | Ground | All the GND pins must be connected to ground |
| 58 | All | GND | - | N/A | Ground | All the GND pins must be connected to ground |
| 59 | All | GND | - | N/A | Ground | All the GND pins must be connected to ground |
| 60 | All | GND | - | N/A | Ground | All the GND pins must be connected to ground |
| 61 | All | GND | - | N/A | Ground | All the GND pins must be connected to ground |
| 62 | All | ANT_DET | ADC | I | Antenna detection | Antenna presence detection function.<br>See section 4.2.5 for detailed electrical specs. |
| 63 | All | GND | - | N/A | Ground | All the GND pins must be connected to ground |
| 64 | All | GND | - | N/A | Ground | All the GND pins must be connected to ground |
| 65-96 | All | GND | - | N/A | Ground | All the GND pins must be connected to ground |

**Table 6: SARA-U2 series module pin-out**

☞ For more information about pin-out see the SARA-G3 and SARA-U2 series System Integration Manual [7].

☞ For an explanation of abbreviations and terms used, see Appendix A.

# 4 Electrical specifications

**Stressing the device above one or more of the ratings listed in the Absolute Maximum Rating section may cause permanent damage. These are stress ratings only. Operating the module at these or at any conditions other than those specified in the Operating Conditions sections (section 4.2) of the specification should be avoided. Exposure to Absolute Maximum Rating conditions for extended periods may affect device reliability.**

Operating conditions ranges define those limits within which the functionality of the device is guaranteed.

Where application information is given, it is advisory only and does not form part of the specification.

## 4.1 Absolute maximum rating

Limiting values given below are in accordance with the Absolute Maximum Rating System (IEC 134).

| Symbol | Description | Condition | Min. | Max. | Unit |
|---|---|---|---|---|---|
| VCC | Module supply voltage | Input DC voltage at VCC pins | -0.30 | 5.50 | V |
| VUSB_DET | USB detection pin | Input DC voltage at VUSB_DET pin | -0.30 | 5.35 | V |
| USB | USB D+/D- pins | Input DC voltage at USB_D+ and USB_D- pins | -1.00 | 5.35 | V |
| V_BCKP | RTC supply voltage | Input DC voltage at V_BCKP pin | -0.15 | 2.00 | V |
| GDI | Generic digital interfaces | Input DC voltage at Generic digital interfaces pins | -0.30 | 3.60 | V |
| DDC | DDC interface | Input DC voltage at DDC interface pins | -0.30 | 3.60 | V |
| SIM | SIM interface | Input DC voltage at SIM interface pin | -0.30 | 3.60 | V |
| ERS | External reset signal | Input DC voltage at RESET_N external reset pin | -0.15 | 2.10 | V |
| POS | Power-on signal | Input DC voltage at PWR_ON power-on pin | -0.30 | 5.50 | V |
| ADC | Antenna detection pin | Input DC voltage at ANT_DET pin | -0.15 | 3.00 | V |
| P_ANT | Antenna power | Input RF power at ANT pin | | -10 | dBm |
| Rho_ANT | Antenna ruggedness | Output RF load mismatch ruggedness at ANT pin | | 15:1 | VSWR |
| Tstg | Storage Temperature | | -40 | 90 | °C |

**Table 7: Absolute maximum ratings**

**The product is not protected against overvoltage or reversed voltages. If necessary, voltage spikes exceeding the power supply voltage specification, given in table above, must be limited to values within the specified boundaries by using appropriate protection devices.**

### 4.1.1 Maximum ESD

| Parameter | Module | Min. | Typ. | Max. | Unit | Remarks |
|---|---|---|---|---|---|---|
| ESD sensitivity for all pins except ANT pin | | | | 1000 | V | Human Body Model according to JESD22-A114F |
| ESD sensitivity for ANT pin | | | | 1000 | V | Human Body Model according to JESD22-A114F |
| ESD immunity for ANT pin | | | | 2000 | V | Contact Discharge according to IEC 61000-4-2 |
| | | | | 4000 | V | Air Discharge according to IEC 61000-4-2 |

**Table 8: Maximum ESD ratings**

**SARA-U2 modules are Electrostatic Sensitive Devices (ESD) and require special precautions when handling. See section 7.4 for ESD handling instructions.**

## 4.2 Operating conditions

Unless otherwise indicated, all operating condition specifications are at an ambient temperature of 25°C.

**Operation beyond the operating conditions is not recommended and extended exposure beyond them may affect device reliability.**

### 4.2.1 Operating temperature range

| Symbol | Parameter | Min. | Typ. | Max. | Units | Remarks |
|---|---|---|---|---|---|---|
| Topr | Operating temperature range | -40 | | +85 | °C | |
| | | -20 | | +55 | °C | Normal operating temperature range<br>See section 4.2.1.1 |
| | | -40 | | -20 | °C | Extended operating temperature range 1<br>See section 4.2.1.2 |
| | | +55 | | +85 | °C | Extended operating temperature range 2<br>See section 4.2.1.3 |

**Table 9: Environmental conditions**

#### 4.2.1.1 Normal operating temperature range

The cellular module is fully functional and meets the 3GPP specification across the specified temperature range.

#### 4.2.1.2 Extended operating temperature range 1

The cellular module is fully functional across the specified temperature range. Occasional deviations from the 3GPP specification may occur.

#### 4.2.1.3 Extended operating temperature range 2

The cellular module is functional across the specified temperature range. Occasional deviations from the 3GPP specification may occur. Thermal protection including automatic shutdown is implemented for protection against overheating. Thermal protection is disabled for emergency calls. For more details, see the u-blox AT Commands Manual [4], +USTS AT command).

### 4.2.2 Supply/Power pins

| Symbol | Parameter | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|
| VCC | Module supply normal operating input voltage[12] | 3.30 | 3.80 | 4.40 | V |
| | Module supply extended operating input voltage[13] | 3.10 | | 4.50 | V |
| V_BCKP | RTC supply input voltage | 1.00 | 1.80 | 1.90 | V |
| I_BCKP | RTC supply average current consumption, at V_BCKP = 1.8 V | | 2.00 | | µA |

**Table 10: Input characteristics of Supply/Power pins**

| Symbol | Parameter | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|
| VSIM | SIM supply output voltage | 1.76 | 1.80 | 1.83 | V |
| | | 2.84 | 2.90 | 2.94 | V |
| V_BCKP | RTC supply output voltage | 1.71 | 1.80 | 1.89 | V |
| I_BCKP | RTC supply output current capability | | | 3 | mA |
| V_INT | Digital I/O Interfaces supply output voltage | 1.73 | 1.80 | 1.87 | V |
| V_INT_RIPPLE | Digital I/O Interfaces supply output peak-to-peak voltage ripple during active or connected mode | | | 15 | mV |
| | Digital I/O Interfaces supply output peak-to-peak voltage ripple during low power idle mode with power saving enabled by AT+UPSV command | | | 70 | mV |
| I_INT | Digital I/O Interfaces supply output current capability | | | 70 | mA |

**Table 11: Output characteristics of Supply/Power pins**

### 4.2.3 Current consumption

| Mode | Condition | Band | Min | Typ[14] | Max[15] | Unit |
|---|---|---|---|---|---|---|
| Power Off Mode | Averaged current, module switched off | | | 65 | | µA |
| Idle-Mode (Power Saving enabled by AT+UPSV, module in low power idle-mode, equivalent to +CFUN=0 or +COPS=2) | Averaged current over a 100-ms period, USB interface disconnected | | | 0.5 | | mA |
| | Averaged current over a 100-ms period, USB interface connected and suspended | | | 0.9 | | mA |
| 2G Cyclic Idle/Active-Mode (Power Saving enabled by AT+UPSV, Module registered with network) | Averaged current over a 10-minute period, DRX = 9[16], AT+UPSV=2 or 3, USB disconnected | All | | 0.9 | | mA |
| | Averaged current over a 10-minute period, DRX = 5[17], AT+UPSV=1, USB disconnected | All | | 1.2 | | mA |
| | Averaged current over a 10-minute period, DRX = 5[17], AT+UPSV=1, USB suspended | All | | 1.6 | | mA |
| 2G Active-Mode (Power Saving disabled by AT+UPSV=0, Module registered with network) | Averaged current over a 10-minute period, DRX = 5[17], USB disconnected | All | | 14.7 | | mA |
| | Averaged current over a 10-minute period, DRX = 5[17], USB connected and not suspended | All | | 34.3 | | mA |

[12] Input voltage at **VCC** must be above the normal operating range minimum limit to switch-on the module.
[13] Occasional deviations from the 3GPP specifications may occur. Ensure that input voltage at **VCC** never drops below the extended operating range minimum limit during module operation: the module may switch-off when the **VCC** voltage value drops below the extended operating range minimum limit.
[14] Typical values with a matched antenna
[15] Maximum values with a mismatched antenna
[16] Module is registered with the network, with a paging period of 2.12 s (2G network DRX setting = 9), with none neighbour cell.
[17] Module is registered with the network, with a paging period of 1.18 s (2G network DRX setting = 5), with 16 neighbour cells.

| Mode | Condition | Band | Min | Typ[14] | Max[15] | Unit |
|---|---|---|---|---|---|---|
| GSM Connected Mode (Tx / Rx call enabled) | Peak current[18] during a 1-slot Tx burst Maximum Tx power | GSM 850 | | 1.50 | 1.90 | A |
| | | EGSM 900 | | 1.55 | 1.90 | A |
| | Averaged current over a 10-second period, 1 Tx + 1 Rx slot, Maximum Tx power | GSM 850 | | 200 | | mA |
| | | EGSM 900 | | 215 | | mA |
| | Averaged current over a 10-second period, 1 Tx + 1 Rx slot, Maximum Tx power | DCS 1800 | | 140 | | mA |
| | | PCS 1900 | | 130 | | mA |
| GPRS Connected Mode (Tx / Rx call enabled) | Averaged current over a 10-second period, 4 Tx + 1 Rx slots, Maximum Tx power[19] | GSM 850 | | 540 | | mA |
| | | EGSM 900 | | 580 | | mA |
| | Averaged current over a 10-second period, 4 Tx + 1 Rx slots, Maximum Tx power[19] | DCS 1800 | | 360 | | mA |
| | | PCS 1900 | | 340 | | mA |
| 3G Cyclic Idle/Active-Mode (Power Saving enabled by AT+UPSV, Module registered with network) | Averaged current over a 10-minute period, DRX = 9[20], AT+UPSV=2 or 3, USB disconnected | All | | 0.9 | | mA |
| | Averaged current over a 10-minute period, DRX = 7[21], AT+UPSV=1, USB disconnected | All | | 1.3 | | mA |
| | Averaged current over a 10-minute period, DRX = 7[21], AT+UPSV=1, USB suspended | All | | 1.7 | | mA |
| 3G Active-Mode (Power Saving disabled by AT+UPSV=0, Module registered with network) | Averaged current over a 10-minute period, DRX = 7[21], USB disconnected | All | | 14.1 | | mA |
| | Averaged current over a 10-minute period, DRX = 7[21], USB connected and not suspended | All | | 33.6 | | mA |
| UMTS Connected Mode (Tx / Rx call enabled) | Averaged current over a 10-second period, 12.2 kb/s UL, 12.2 kb/s DL Tx power = -55 dBm | Band I (2100) | | 125 | | mA |
| | | Band II (1900) | | 115 | | mA |
| | | Band V (850) | | 110 | | mA |
| | | Band VIII (900) | | 125 | | mA |
| | Averaged current over a 10-second period, 12.2 kb/s UL, 12.2 kb/s DL Tx power = 0 dBm | Band I (2100) | | 150 | | mA |
| | | Band II (1900) | | 140 | | mA |
| | | Band V (850) | | 135 | | mA |
| | | Band VIII (900) | | 140 | | mA |
| | Averaged current over a 10-second period, 12.2 kb/s UL, 12.2 kb/s DL Tx power = 12 dBm | Band I (2100) | | 210 | | mA |
| | | Band II (1900) | | 220 | | mA |
| | | Band V (850) | | 185 | | mA |
| | | Band VIII (900) | | 200 | | mA |
| | Averaged current over a 10-second period, 12.2 kb/s UL, 12.2 kb/s DL Tx power = 18 dBm | Band I (2100) | | 345 | | mA |
| | | Band II (1900) | | 360 | | mA |
| | | Band V (850) | | 315 | | mA |
| | | Band VIII (900) | | 335 | | mA |
| | Averaged current over a 10-second period, 12.2 kb/s UL, 12.2 kb/s DL Maximum Tx power | Band I (2100) | | 610 | | mA |
| | | Band II (1900) | | 640 | | mA |
| | | Band V (850) | | 540 | | mA |
| | | Band VIII (900) | | 590 | | mA |
| HSDPA Connected Mode (Tx / Rx call enabled) | Averaged current over a 10-second period, Max. DL data rate (HSDPA) Maximum Tx power | Band I (2100) | | 690 | | mA |
| | | Band II (1900) | | 670 | | mA |
| | | Band V (850) | | 570 | | mA |
| | | Band VIII (900) | | 620 | | mA |
| HSUPA or HSPA Connected Mode (Tx / Rx call enabled) | Averaged current over a 10-second period, Max. UL or both UL/DL data rate (HSUPA or HSPA) Maximum Tx power | Band I (2100) | | 585 | | mA |
| | | Band II (1900) | | 580 | | mA |
| | | Band V (850) | | 490 | | mA |
| | | Band VIII (900) | | 535 | | mA |

**Table 12: VCC current consumption**

[18] It is recommended to use this figure to dimension maximum current capability of power supply.
[19] Condition for GPRS multi-slot output power: Multi-Slot Power Reduction profile 2 (+UDCONF=40 AT command default value).
[20] Module is registered with the network, with a paging period of 5.12 s (3G network DRX setting = 9).
[21] Module is registered with the network, with a paging period of 1.28 s (3G network DRX setting = 7).

### 4.2.4 RF characteristics

The 3G and 2G bands supported by each SARA-U2 series module are defined in Table 2, while the following Table 13 lists the Transmitting and Receiving frequencies for each 3G and 2G band, according to 3GPP TS 34.121-1 [14] and 3GPP TS 51.010-1 [15].

| Parameter | | Min. | Max. | Unit | Remarks |
|---|---|---|---|---|---|
| Frequency range GSM 850 | Uplink | 824 | 849 | MHz | Module transmit |
| | Downlink | 869 | 894 | MHz | Module receive |
| Frequency range E-GSM 900 | Uplink | 880 | 915 | MHz | Module transmit |
| | Downlink | 925 | 960 | MHz | Module receive |
| Frequency range DCS 1800 | Uplink | 1710 | 1785 | MHz | Module transmit |
| | Downlink | 1805 | 1880 | MHz | Module receive |
| Frequency range PCS 1900 | Uplink | 1850 | 1910 | MHz | Module transmit |
| | Downlink | 1930 | 1990 | MHz | Module receive |
| Frequency range Band 5 (850 MHz) | Uplink | 824 | 849 | MHz | Module transmit |
| | Downlink | 869 | 894 | MHz | Module receive |
| Frequency range Band 8 (900 MHz) | Uplink | 880 | 915 | MHz | Module transmit |
| | Downlink | 925 | 960 | MHz | Module receive |
| Frequency range Band 2 (1900 MHz) | Uplink | 1850 | 1910 | MHz | Module transmit |
| | Downlink | 1930 | 1990 | MHz | Module receive |
| Frequency range Band 1 (2100 MHz) | Uplink | 1920 | 1980 | MHz | Module transmit |
| | Downlink | 2110 | 2170 | MHz | Module receive |

**Table 13: Operating RF frequency bands**

SARA-U2 series modules include a UE Power Class 3 3G transmitter, a GMSK Power Class 4 transmitter for GSM/E-GSM bands, and a GMSK Power Class 1 transmitter for DCS/PCS bands (see Table 2). Output power and characteristics are compliant with 3GPP TS 34.121-1 [14] and 3GPP TS 51.010-1 [15].

SARA-U2 series modules 3G and 2G receiver characteristics are compliant to 3GPP TS 34.121-1 [14] and 3GPP TS 51.010-1 [15], with conducted receiver sensitivity performance specified in Table 14.

| Parameter | Min. | Typ. | Max. | Unit | Remarks |
|---|---|---|---|---|---|
| Receiver input sensitivity GSM 850 / E-GSM 900 | | -109.0 | | dBm | Downlink RF level @ BER Class II < 2.4 % |
| Receiver input sensitivity DCS 1800 / PCS 1900 | | -109.0 | | dBm | Downlink RF level @ BER Class II < 2.4 % |
| Receiver input sensitivity Band 5 (850 MHz) | | -111.0 | | dBm | Downlink RF level for RMC @ BER < 0.1 % |
| Receiver input sensitivity Band 8 (900 MHz) | | -110.0 | | dBm | Downlink RF level for RMC @ BER < 0.1 % |
| Receiver input sensitivity Band 2 (1900 MHz) | | -110.0 | | dBm | Downlink RF level for RMC @ BER < 0.1 % |
| Receiver input sensitivity Band 1 (2100 MHz) | | -110.0 | | dBm | Downlink RF level for RMC @ BER < 0.1 % |

Condition: 50 Ω source

**Table 14: Receiver sensitivity performance**

### 4.2.5 ANT_DET pin

| Pin Name | Parameter | Min. | Typ. | Max. | Unit | Remarks |
|---|---|---|---|---|---|---|
| ANT_DET | Output DC current pulse value | | 10 | | µA | |
| | Output DC current pulse time length | | 128 | | µs | |

**Table 15: ANT_DET pin characteristics**

### 4.2.6 PWR_ON pin

| Pin Name | Parameter | Min. | Typ. | Max. | Unit | Remarks |
|---|---|---|---|---|---|---|
| PWR_ON | Internal supply for Power-On Input Signal | 1.71 | 1.80 | 1.89 | V | RTC supply (V_BCKP) |
| | L-level input | -0.30 | | 0.65 | V | High input impedance (no internal pull-up) |
| | H-level input | 1.50 | | 4.40 | V | High input impedance (no internal pull-up) |
| | L-level input current | | -6 | | µA | |
| | PWR_ON low time to switch-on the module | 50 | | 80 | µs | |
| | PWR_ON low time to switch-off the module | 1000 | | | ms | |

**Table 16: PWR_ON pin characteristics (POS domain)**

### 4.2.7 RESET_N pin

| Pin Name | Parameter | Min. | Typ. | Max. | Unit | Remarks |
|---|---|---|---|---|---|---|
| RESET_N | Internal supply for External Reset Input Signal | 1.71 | 1.80 | 1.89 | V | RTC supply (V_BCKP) |
| | L-level input | -0.30 | | 0.51 | V | |
| | H-level input | 1.32 | | 2.01 | V | |
| | L-level input current | | -180 | | µA | |
| | Pull-up resistance | | 10 | | kΩ | Internal pull-up to RTC supply (V_BCKP) |
| | RESET_N low time to perform a proper reset | 50 | | | ms | |

**Table 17: RESET_N pin characteristics (ERS domain)**

### 4.2.8 (U)SIM pins

The SIM pins are a dedicated interface to the external SIM card/chip. The electrical characteristics fulfill regulatory specification requirements. The values in Table 18 are for information only.

| Parameter | Min. | Typ. | Max. | Unit | Remarks |
|---|---|---|---|---|---|
| Low-level input | 0.00 | | 0.35 | V | VSIM = 1.80 V |
| | 0.00 | | 0.57 | V | VSIM = 2.90 V |
| High-level input | 1.29 | | 3.30 | V | VSIM = 1.80 V |
| | 2.07 | | 3.30 | V | VSIM = 2.90 V |
| Low-level output | | 0.00 | 0.35 | V | VSIM = 1.80 V, Max value at $I_{OL}$ = +1.0 mA |
| | | 0.00 | 0.35 | V | VSIM = 2.90 V, Max value at $I_{OL}$ = +1.0 mA |
| High-level output | 1.26 | 1.80 | | V | VSIM = 1.80 V, Min value at $I_{OH}$ = -1.0 mA |
| | 2.03 | 2.90 | | V | VSIM = 2.90 V, Min value at $I_{OH}$ = -1.0 mA |
| Input/Output leakage current | | | 0.7 | µA | 0.2V < $V_{IN}$ < 3.3V |
| Internal pull-up resistor on SIM_IO to VSIM | | 4.7 | | kΩ | |
| Clock frequency on SIM_CLK | | 3.25 | | MHz | |

**Table 18: (U)SIM pins characteristics (SIM domain)**

### 4.2.9 Generic Digital Interfaces pins

| Parameter | Min. | Typ. | Max. | Unit | Remarks |
|---|---|---|---|---|---|
| Internal supply for GDI domain | 1.73 | 1.80 | 1.87 | V | Generic Digital Interfaces supply (V_INT) |
| Input characteristic: L-level input | -0.20 | | 0.35 | V | |
| Input characteristic: H-level input | 1.31 | | 1.93 | V | |
| Output characteristics: L-level output | | 0.00 | 0.20 | V | Max value at $I_{OL}$ = +0.1 mA for driver class A |
| | | 0.00 | 0.35 | V | Max value at $I_{OL}$ = +6.0 mA for driver class A |
| | | 0.00 | 0.20 | V | Max value at $I_{OL}$ = +0.1 mA for driver class B |
| | | 0.00 | 0.35 | V | Max value at $I_{OL}$ = +4.0 mA for driver class B |
| | | 0.00 | 0.20 | V | Max value at $I_{OL}$ = +0.1 mA for driver class C |
| | | 0.00 | 0.35 | V | Max value at $I_{OL}$ = +2.0 mA for driver class C |
| | | 0.00 | 0.45 | V | Max value at $I_{OL}$ = +2.0 mA for driver class C_0 |
| | | 0.00 | 0.20 | V | Max value at $I_{OL}$ = +0.1mA for driver class D |
| | | 0.00 | 0.35 | V | Max value at $I_{OL}$ = +1.0 mA for driver class D |
| | | 0.00 | 0.20 | V | Max value at $I_{OL}$ = +0.1 mA for driver class E |
| Output characteristics: H-level output | 1.45 | 1.80 | | V | Min value at $I_{OH}$ = -6.0 mA for driver class A |
| | 1.60 | 1.80 | | V | Min value at $I_{OH}$ = -0.1 mA for driver class A |
| | 1.45 | 1.80 | | V | Min value at $I_{OH}$ = -4.0 mA for driver class B |
| | 1.60 | 1.80 | | V | Min value at $I_{OH}$ = -0.1 mA for driver class B |
| | 1.45 | 1.80 | | V | Min value at $I_{OH}$ = -2.0 mA for driver class C |
| | 1.60 | 1.80 | | V | Min value at $I_{OH}$ = -0.1 mA for driver class C |
| | 1.35 | 1.80 | | V | Min value at $I_{OH}$ = -2.0 mA for driver class C_0 |
| | 1.45 | 1.80 | | V | Min value at $I_{OH}$ = -1.0 mA for driver class D |
| | 1.60 | 1.80 | | V | Min value at $I_{OH}$ = -0.1 mA for driver class D |
| | 1.60 | 1.80 | | V | Min value at $I_{OH}$ = -0.1 mA for driver class E |
| Input/Output leakage current | | | 0.7 | µA | 0.2 V < $V_{IN}$ < 1.93 V |
| Pull-up input current | | | -240 | µA | PU Class a |
| | | | -150 | µA | PU Class b |
| | | | -125 | µA | PU Class c |
| Pull-down input current | | | +200 | µA | PD Class a |
| | | | +150 | µA | PD Class b |
| | | | +45 | µA | PD Class c |

**Table 19: Generic Digital Interfaces pins characteristics (GDI domain)**

#### 4.2.9.1 AC characteristics of digital audio interfaces pins

The 4-wire $I^2S$ digital audio interface can be configured in 4 different modes:

- Normal $I^2S$ mode – Master mode
- Normal $I^2S$ mode – Slave mode
- PCM mode – Master mode
- PCM mode – Slave mode

AC characteristics of the 4 different modes of the $I^2S$ digital audio interface are reported as follows.

### Normal I²S mode – Master mode

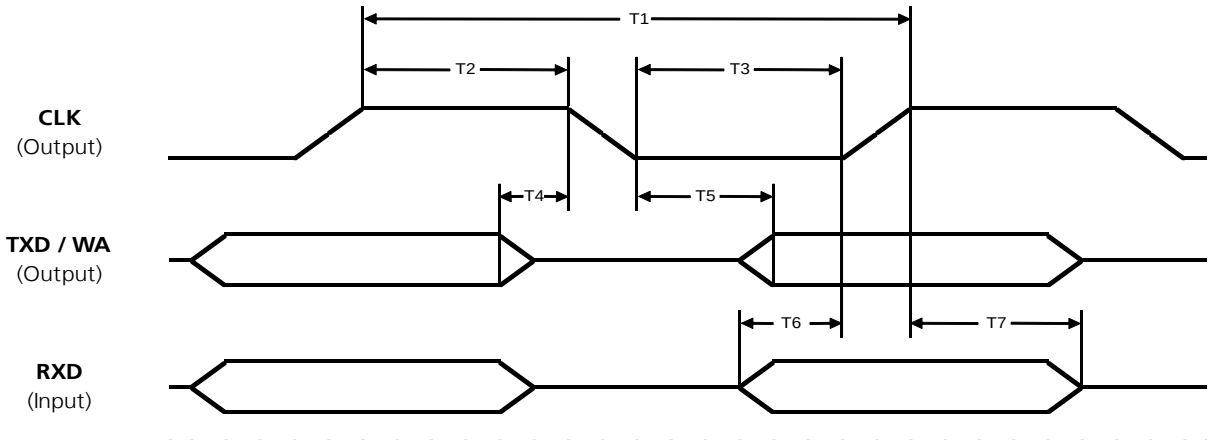


**Figure 4: AC characteristics of digital audio interface in Normal I²S mode (<I2S_mode> = 2,4,6,8,10,12) and Master mode enabled**

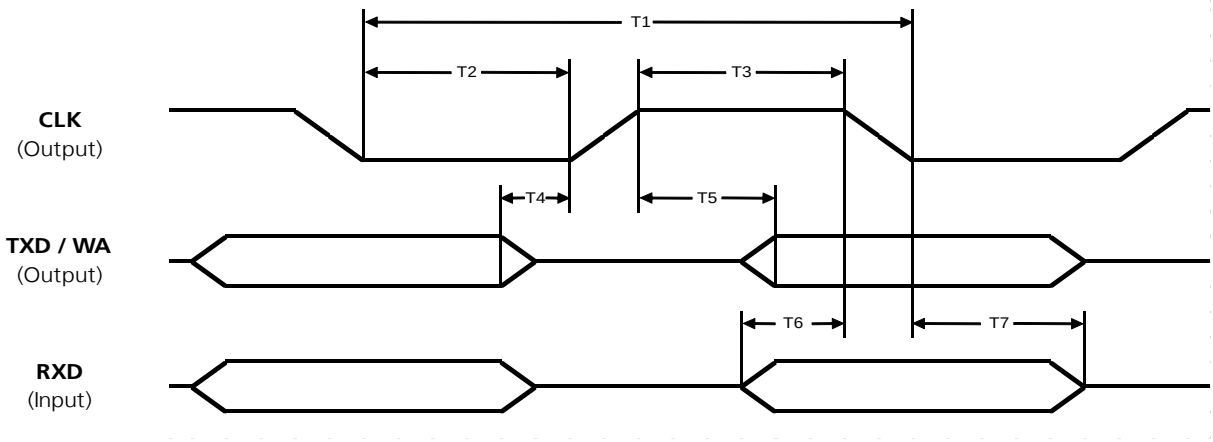


**Figure 5: AC characteristics of digital audio interface in Normal I²S mode (<I2S_mode> = 3,5,7,9,11,13) and Master mode enabled**

| Parameter | Description | Min. | Typ. | Max. | Unit | Remarks |
|---|---|---|---|---|---|---|
| T1 | I²S clock period | 3.902 | 3.906 | | µs | <I2S_sample_rate>=0 |
| | | 2.830 | 2.834 | | µs | <I2S_sample_rate>=1 |
| | | 2.600 | 2.604 | | µs | <I2S_sample_rate>=2 |
| | | 1.949 | 1.953 | | µs | <I2S_sample_rate>=3 |
| | | 1.413 | 1.417 | | µs | <I2S_sample_rate>=4 |
| | | 1.298 | 1.302 | | µs | <I2S_sample_rate>=5 |
| | | 0.973 | 0.977 | | µs | <I2S_sample_rate>=6 |
| | | 0.705 | 0.709 | | µs | <I2S_sample_rate>=7 |
| | | 0.647 | 0.651 | | µs | <I2S_sample_rate>=8 |
| 1/T1 | I²S clock frequency | | 256.0 | 256.3 | kHz | <I2S_sample_rate>=0 |
| | | | 352.8 | 353.3 | kHz | <I2S_sample_rate>=1 |
| | | | 384.0 | 384.6 | kHz | <I2S_sample_rate>=2 |
| | | | 512.0 | 513.1 | kHz | <I2S_sample_rate>=3 |
| | | | 705.6 | 707.6 | kHz | <I2S_sample_rate>=4 |
| | | | 768.0 | 770.4 | kHz | <I2S_sample_rate>=5 |
| | | | 1024 | 1028 | kHz | <I2S_sample_rate>=6 |
| | | | 1411 | 1419 | kHz | <I2S_sample_rate>=7 |
| | | | 1536 | 1545 | kHz | <I2S_sample_rate>=8 |

| Parameter | Description | Min. | Typ. | Max. | Unit | Remarks |
|---|---|---|---|---|---|---|
| T2 | $I^2S$ clock high time | 1.933 | 1.953 | | µs | <I2S_sample_rate>=0 |
| | | 1.397 | 1.417 | | µs | <I2S_sample_rate>=1 |
| | | 1.282 | 1.302 | | µs | <I2S_sample_rate>=2 |
| | | 0.957 | 0.977 | | µs | <I2S_sample_rate>=3 |
| | | 0.689 | 0.709 | | µs | <I2S_sample_rate>=4 |
| | | 0.631 | 0.651 | | µs | <I2S_sample_rate>=5 |
| | | 0.468 | 0.488 | | µs | <I2S_sample_rate>=6 |
| | | 0.334 | 0.354 | | µs | <I2S_sample_rate>=7 |
| | | 0.306 | 0.326 | | µs | <I2S_sample_rate>=8 |
| T3 | $I^2S$ clock low time | 1.933 | 1.953 | | µs | <I2S_sample_rate>=0 |
| | | 1.397 | 1.417 | | µs | <I2S_sample_rate>=1 |
| | | 1.282 | 1.302 | | µs | <I2S_sample_rate>=2 |
| | | 0.957 | 0.977 | | µs | <I2S_sample_rate>=3 |
| | | 0.689 | 0.709 | | µs | <I2S_sample_rate>=4 |
| | | 0.631 | 0.651 | | µs | <I2S_sample_rate>=5 |
| | | 0.468 | 0.488 | | µs | <I2S_sample_rate>=6 |
| | | 0.334 | 0.354 | | µs | <I2S_sample_rate>=7 |
| | | 0.306 | 0.326 | | µs | <I2S_sample_rate>=8 |
| | $I^2S$ word alignment period | | 125.0 | | µs | <I2S_sample_rate>=0 |
| | | | 90.70 | | µs | <I2S_sample_rate>=1 |
| | | | 83.33 | | µs | <I2S_sample_rate>=2 |
| | | | 62.50 | | µs | <I2S_sample_rate>=3 |
| | | | 45.35 | | µs | <I2S_sample_rate>=4 |
| | | | 41.67 | | µs | <I2S_sample_rate>=5 |
| | | | 31.25 | | µs | <I2S_sample_rate>=6 |
| | | | 22.68 | | µs | <I2S_sample_rate>=7 |
| | | | 20.83 | | µs | <I2S_sample_rate>=8 |
| | $I^2S$ word alignment frequency | | 8.000 | | kHz | <I2S_sample_rate>=0 |
| | | | 11.03 | | kHz | <I2S_sample_rate>=1 |
| | | | 12.00 | | kHz | <I2S_sample_rate>=2 |
| | | | 16.00 | | kHz | <I2S_sample_rate>=3 |
| | | | 22.05 | | kHz | <I2S_sample_rate>=4 |
| | | | 24.00 | | kHz | <I2S_sample_rate>=5 |
| | | | 32.00 | | kHz | <I2S_sample_rate>=6 |
| | | | 44.10 | | kHz | <I2S_sample_rate>=7 |
| | | | 48.00 | | kHz | <I2S_sample_rate>=8 |
| T4 | $I^2S$ TXD invalid before $I^2S$ CLK high end (before shifting edge of $I^2S$ CLK) | | | 24 | ns | <I2S_mode> = 2,4,6,8,10,12 |
| | $I^2S$ TXD invalid before $I^2S$ CLK low end (before shifting edge of $I^2S$ CLK) | | | 24 | ns | <I2S_mode> = 3,5,7,9,11,13 |
| T5 | $I^2S$ TXD valid after $I^2S$ CLK low begin (after shifting edge of $I^2S$ CLK) | | | 32 | ns | <I2S_mode> = 2,4,6,8,10,12 |
| | $I^2S$ TXD valid after $I^2S$ CLK high begin (after shifting edge of $I^2S$ CLK) | | | 32 | ns | <I2S_mode> = 3,5,7,9,11,13 |
| T6 | $I^2S$ RXD setup time before $I^2S$ CLK low end (before latching edge of $I^2S$ CLK) | 60 | | | ns | <I2S_mode> = 2,4,6,8,10,12 |
| | $I^2S$ RXD setup time before $I^2S$ CLK high end (before latching edge of $I^2S$ CLK) | 60 | | | ns | <I2S_mode> = 3,5,7,9,11,13 |
| T7 | $I^2S$ RXD hold time after $I^2S$ CLK high begin (after latching edge of $I^2S$ CLK) | 10 | | | ns | <I2S_mode> = 2,4,6,8,10,12 |
| | $I^2S$ RXD hold time after $I^2S$ CLK low begin (after latching edge of $I^2S$ CLK) | 10 | | | ns | <I2S_mode> = 3,5,7,9,11,13 |

**Table 20: AC characteristics of digital audio interface in Normal $I^2S$ mode and Master mode enabled**

### Normal I²S mode – Slave mode

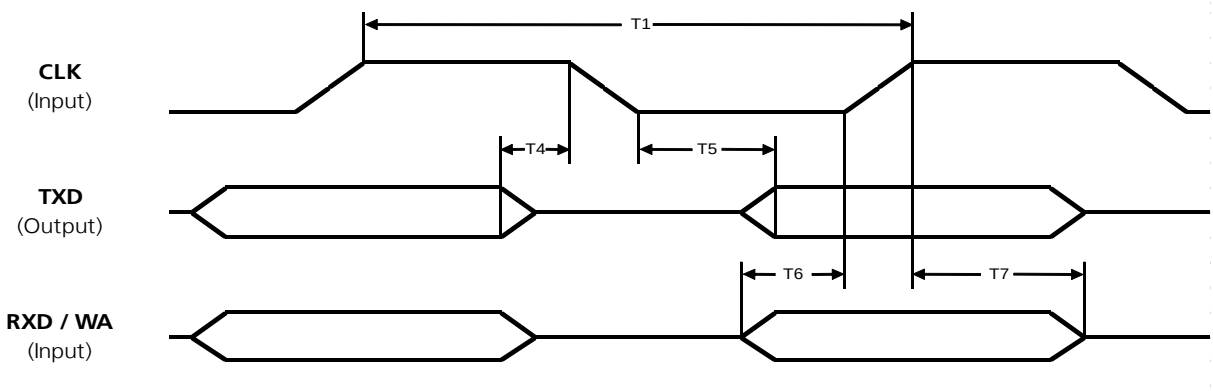


**Figure 6: AC characteristics of digital audio interface in Normal I²S mode (<I2S_mode> = 2,4,6,8,10,12) and Slave mode enabled**

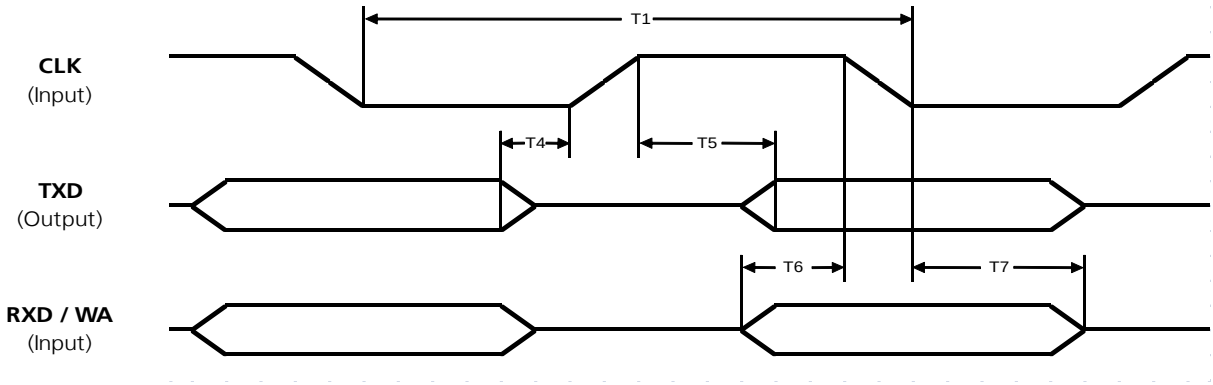


**Figure 7: AC characteristics of digital audio interface in Normal I²S mode (<I2S_mode> = 3,5,7,9,11,13) and Slave mode enabled**

| Parameter | Description | Min. | Typ. | Max. | Unit | Remarks |
|---|---|---|---|---|---|---|
| T1 | I²S clock period | 3.906 | | | µs | <I2S_sample_rate>=0 |
| | | 2.834 | | | µs | <I2S_sample_rate>=1 |
| | | 2.604 | | | µs | <I2S_sample_rate>=2 |
| | | 1.953 | | | µs | <I2S_sample_rate>=3 |
| | | 1.417 | | | µs | <I2S_sample_rate>=4 |
| | | 1.302 | | | µs | <I2S_sample_rate>=5 |
| | | 0.977 | | | µs | <I2S_sample_rate>=6 |
| | | 0.709 | | | µs | <I2S_sample_rate>=7 |
| | | 0.651 | | | µs | <I2S_sample_rate>=8 |
| 1/T1 | I²S clock frequency | | | 256.0 | kHz | <I2S_sample_rate>=0 |
| | | | | 352.8 | kHz | <I2S_sample_rate>=1 |
| | | | | 384.0 | kHz | <I2S_sample_rate>=2 |
| | | | | 512.0 | kHz | <I2S_sample_rate>=3 |
| | | | | 705.6 | kHz | <I2S_sample_rate>=4 |
| | | | | 768.0 | kHz | <I2S_sample_rate>=5 |
| | | | | 1024 | kHz | <I2S_sample_rate>=6 |
| | | | | 1411 | kHz | <I2S_sample_rate>=7 |
| | | | | 1536 | kHz | <I2S_sample_rate>=8 |

| Parameter | Description | Min. | Typ. | Max. | Unit | Remarks |
|---|---|---|---|---|---|---|
| | I²S word alignment period | 125.0 | | | µs | <I2S_sample_rate>=0 |
| | | 90.70 | | | µs | <I2S_sample_rate>=1 |
| | | 83.33 | | | µs | <I2S_sample_rate>=2 |
| | | 62.50 | | | µs | <I2S_sample_rate>=3 |
| | | 45.35 | | | µs | <I2S_sample_rate>=4 |
| | | 41.67 | | | µs | <I2S_sample_rate>=5 |
| | | 31.25 | | | µs | <I2S_sample_rate>=6 |
| | | 22.68 | | | µs | <I2S_sample_rate>=7 |
| | | 20.83 | | | µs | <I2S_sample_rate>=8 |
| | I²S word alignment frequency | | | 8.000 | kHz | <I2S_sample_rate>=0 |
| | | | | 11.03 | kHz | <I2S_sample_rate>=1 |
| | | | | 12.00 | kHz | <I2S_sample_rate>=2 |
| | | | | 16.00 | kHz | <I2S_sample_rate>=3 |
| | | | | 22.05 | kHz | <I2S_sample_rate>=4 |
| | | | | 24.00 | kHz | <I2S_sample_rate>=5 |
| | | | | 32.00 | kHz | <I2S_sample_rate>=6 |
| | | | | 44.10 | kHz | <I2S_sample_rate>=7 |
| | | | | 48.00 | kHz | <I2S_sample_rate>=8 |
| T4 | I²S TXD invalid before I²S CLK falling edge (before shifting edge of I²S CLK) | | | 24 | ns | <I2S_mode> = 2,4,6,8,10,12 |
| | I²S TXD invalid before I²S CLK rising edge (before shifting edge of I²S CLK) | | | 24 | ns | <I2S_mode> = 3,5,7,9,11,13 |
| T5 | I²S TXD valid after I²S CLK falling edge (after shifting edge of I²S CLK) | | | 32 | ns | <I2S_mode> = 2,4,6,8,10,12 |
| | I²S TXD valid after I²S CLK rising edge (after shifting edge of I²S CLK) | | | 32 | ns | <I2S_mode> = 3,5,7,9,11,13 |
| T6 | I²S RXD setup time before I²S CLK rising edge (before latching edge of I²S CLK) | 60 | | | ns | <I2S_mode> = 2,4,6,8,10,12 |
| | I²S RXD setup time before I²S CLK falling edge (before latching edge of I²S CLK) | 60 | | | ns | <I2S_mode> = 3,5,7,9,11,13 |
| T7 | I²S RXD hold time after I²S CLK rising edge (after latching edge of I²S CLK) | 10 | | | ns | <I2S_mode> = 2,4,6,8,10,12 |
| | I²S RXD hold time after I²S CLK falling edge (after latching edge of I²S CLK) | 10 | | | ns | <I2S_mode> = 3,5,7,9,11,13 |

**Table 21: AC characteristics of digital audio interface in Normal I²S mode and Slave mode enabled**

### PCM mode – Master mode

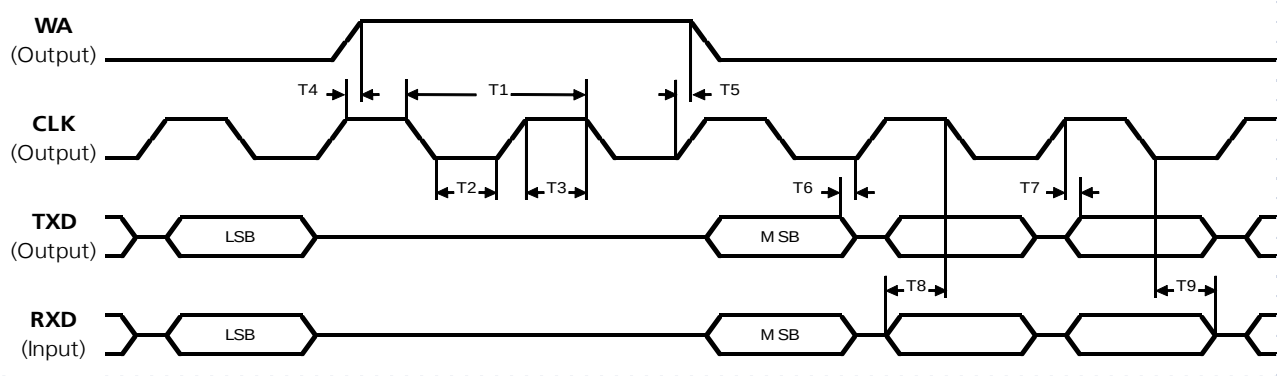


**Figure 8: AC characteristics of digital audio interface in PCM mode (<I2S_mode> = 0) and Master mode enabled**

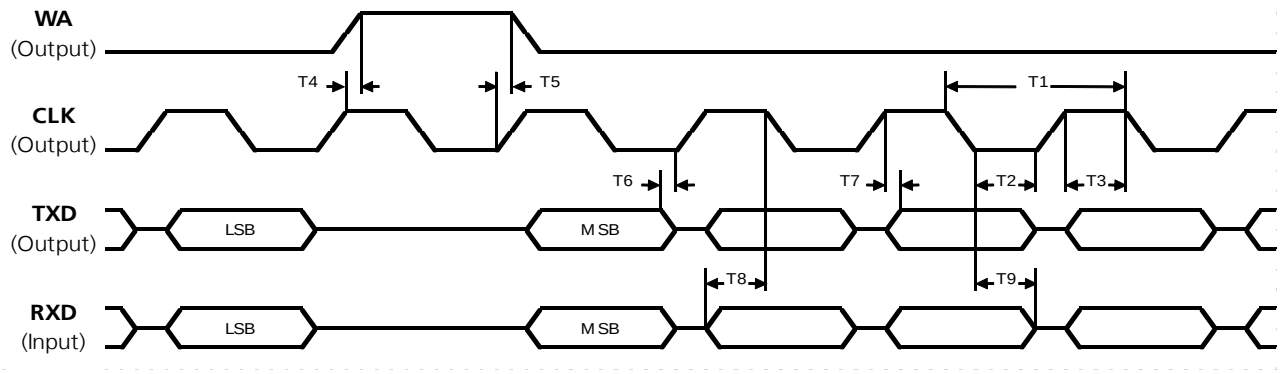


**Figure 9: AC characteristics of digital audio interface in PCM mode (<I2S_mode> = 1) and Master mode enabled**

| Parameter | Description | Min. | Typ. | Max. | Unit | Remarks |
|---|---|---|---|---|---|---|
| T1 | $I^2S$ clock period | 6.940 | 6.944 | | µs | <I2S_mode>=0, <I2S_sample_rate>=0 |
| | | 7.349 | 7.353 | | µs | <I2S_mode>=1, <I2S_sample_rate>=0 |
| | | 5.035 | 5.039 | | µs | <I2S_mode>=0, <I2S_sample_rate>=1 |
| | | 5.331 | 5.335 | | µs | <I2S_mode>=1, <I2S_sample_rate>=1 |
| | | 4.626 | 4.630 | | µs | <I2S_mode>=0, <I2S_sample_rate>=2 |
| | | 4.898 | 4.902 | | µs | <I2S_mode>=1, <I2S_sample_rate>=2 |
| | | 3.468 | 3.472 | | µs | <I2S_mode>=0, <I2S_sample_rate>=3 |
| | | 3.672 | 3.676 | | µs | <I2S_mode>=1, <I2S_sample_rate>=3 |
| | | 2.516 | 2.520 | | µs | <I2S_mode>=0, <I2S_sample_rate>=4 |
| | | 2.664 | 2.668 | | µs | <I2S_mode>=1, <I2S_sample_rate>=4 |
| | | 2.311 | 2.315 | | µs | <I2S_mode>=0, <I2S_sample_rate>=5 |
| | | 2.447 | 2.451 | | µs | <I2S_mode>=1, <I2S_sample_rate>=5 |
| | | 1.732 | 1.736 | | µs | <I2S_mode>=0, <I2S_sample_rate>=6 |
| | | 1.834 | 1.838 | | µs | <I2S_mode>=1, <I2S_sample_rate>=6 |
| | | 1.256 | 1.260 | | µs | <I2S_mode>=0, <I2S_sample_rate>=7 |
| | | 1.330 | 1.334 | | µs | <I2S_mode>=1, <I2S_sample_rate>=7 |
| | | 1.153 | 1.157 | | µs | <I2S_mode>=0, <I2S_sample_rate>=8 |
| | | 1.221 | 1.225 | | µs | <I2S_mode>=1, <I2S_sample_rate>=8 |

| Parameter | Description | Min. | Typ. | Max. | Unit | Remarks |
|---|---|---|---|---|---|---|
| 1/T1 | $I^2S$ clock frequency | | 144.0 | 144.1 | kHz | <I2S_mode>=0, <I2S_sample_rate>=0 |
| | | | 136.0 | 136.1 | kHz | <I2S_mode>=1, <I2S_sample_rate>=0 |
| | | | 198.5 | 198.6 | kHz | <I2S_mode>=0, <I2S_sample_rate>=1 |
| | | | 187.4 | 187.6 | kHz | <I2S_mode>=1, <I2S_sample_rate>=1 |
| | | | 216.0 | 216.2 | kHz | <I2S_mode>=0, <I2S_sample_rate>=2 |
| | | | 204.0 | 204.2 | kHz | <I2S_mode>=1, <I2S_sample_rate>=2 |
| | | | 288.0 | 288.3 | kHz | <I2S_mode>=0, <I2S_sample_rate>=3 |
| | | | 272.0 | 272.3 | kHz | <I2S_mode>=1, <I2S_sample_rate>=3 |
| | | | 396.9 | 397.5 | kHz | <I2S_mode>=0, <I2S_sample_rate>=4 |
| | | | 374.9 | 375.4 | kHz | <I2S_mode>=1, <I2S_sample_rate>=4 |
| | | | 432.0 | 432.7 | kHz | <I2S_mode>=0, <I2S_sample_rate>=5 |
| | | | 408.0 | 408.7 | kHz | <I2S_mode>=1, <I2S_sample_rate>=5 |
| | | | 576.0 | 577.3 | kHz | <I2S_mode>=0, <I2S_sample_rate>=6 |
| | | | 544.0 | 545.2 | kHz | <I2S_mode>=1, <I2S_sample_rate>=6 |
| | | | 793.8 | 796.3 | kHz | <I2S_mode>=0, <I2S_sample_rate>=7 |
| | | | 749.7 | 752.0 | kHz | <I2S_mode>=1, <I2S_sample_rate>=7 |
| | | | 864.0 | 867.0 | kHz | <I2S_mode>=0, <I2S_sample_rate>=8 |
| | | | 816.0 | 818.7 | kHz | <I2S_mode>=1, <I2S_sample_rate>=8 |
| T2 | $I^2S$ clock low time | 3.452 | 3.472 | | µs | <I2S_mode>=0, <I2S_sample_rate>=0 |
| | | 3.656 | 3.676 | | µs | <I2S_mode>=1, <I2S_sample_rate>=0 |
| | | 2.500 | 2.520 | | µs | <I2S_mode>=0, <I2S_sample_rate>=1 |
| | | 2.648 | 2.668 | | µs | <I2S_mode>=1, <I2S_sample_rate>=1 |
| | | 2.295 | 2.315 | | µs | <I2S_mode>=0, <I2S_sample_rate>=2 |
| | | 2.431 | 2.451 | | µs | <I2S_mode>=1, <I2S_sample_rate>=2 |
| | | 1.716 | 1.736 | | µs | <I2S_mode>=0, <I2S_sample_rate>=3 |
| | | 1.818 | 1.838 | | µs | <I2S_mode>=1, <I2S_sample_rate>=3 |
| | | 1.240 | 1.260 | | µs | <I2S_mode>=0, <I2S_sample_rate>=4 |
| | | 1.314 | 1.334 | | µs | <I2S_mode>=1, <I2S_sample_rate>=4 |
| | | 1.137 | 1.157 | | µs | <I2S_mode>=0, <I2S_sample_rate>=5 |
| | | 1.205 | 1.225 | | µs | <I2S_mode>=1, <I2S_sample_rate>=5 |
| | | 0.848 | 0.868 | | µs | <I2S_mode>=0, <I2S_sample_rate>=6 |
| | | 0.899 | 0.919 | | µs | <I2S_mode>=1, <I2S_sample_rate>=6 |
| | | 0.610 | 0.630 | | µs | <I2S_mode>=0, <I2S_sample_rate>=7 |
| | | 0.647 | 0.667 | | µs | <I2S_mode>=1, <I2S_sample_rate>=7 |
| | | 0.559 | 0.579 | | µs | <I2S_mode>=0, <I2S_sample_rate>=8 |
| | | 0.593 | 0.613 | | µs | <I2S_mode>=1, <I2S_sample_rate>=8 |
| T3 | $I^2S$ clock high time | 3.452 | 3.472 | | µs | <I2S_mode>=0, <I2S_sample_rate>=0 |
| | | 3.656 | 3.676 | | µs | <I2S_mode>=1, <I2S_sample_rate>=0 |
| | | 2.500 | 2.520 | | µs | <I2S_mode>=0, <I2S_sample_rate>=1 |
| | | 2.648 | 2.668 | | µs | <I2S_mode>=1, <I2S_sample_rate>=1 |
| | | 2.295 | 2.315 | | µs | <I2S_mode>=0, <I2S_sample_rate>=2 |
| | | 2.431 | 2.451 | | µs | <I2S_mode>=1, <I2S_sample_rate>=2 |
| | | 1.716 | 1.736 | | µs | <I2S_mode>=0, <I2S_sample_rate>=3 |
| | | 1.818 | 1.838 | | µs | <I2S_mode>=1, <I2S_sample_rate>=3 |
| | | 1.240 | 1.260 | | µs | <I2S_mode>=0, <I2S_sample_rate>=4 |
| | | 1.314 | 1.334 | | µs | <I2S_mode>=1, <I2S_sample_rate>=4 |
| | | 1.137 | 1.157 | | µs | <I2S_mode>=0, <I2S_sample_rate>=5 |
| | | 1.205 | 1.225 | | µs | <I2S_mode>=1, <I2S_sample_rate>=5 |
| | | 0.848 | 0.868 | | µs | <I2S_mode>=0, <I2S_sample_rate>=6 |
| | | 0.899 | 0.919 | | µs | <I2S_mode>=1, <I2S_sample_rate>=6 |
| | | 0.610 | 0.630 | | µs | <I2S_mode>=0, <I2S_sample_rate>=7 |
| | | 0.647 | 0.667 | | µs | <I2S_mode>=1, <I2S_sample_rate>=7 |

| Parameter | Description | Min. | Typ. | Max. | Unit | Remarks |
|---|---|---|---|---|---|---|
| | | 0.559 | 0.579 | | µs | <I2S_mode>=0, <I2S_sample_rate>=8 |
| | | 0.593 | 0.613 | | µs | <I2S_mode>=1, <I2S_sample_rate>=8 |
| | $I^2S$ word alignment period | | 125.0 | | µs | <I2S_sample_rate>=0 |
| | | | 90.70 | | µs | <I2S_sample_rate>=1 |
| | | | 83.33 | | µs | <I2S_sample_rate>=2 |
| | | | 62.50 | | µs | <I2S_sample_rate>=3 |
| | | | 45.35 | | µs | <I2S_sample_rate>=4 |
| | | | 41.67 | | µs | <I2S_sample_rate>=5 |
| | | | 31.25 | | µs | <I2S_sample_rate>=6 |
| | | | 22.68 | | µs | <I2S_sample_rate>=7 |
| | | | 20.83 | | µs | <I2S_sample_rate>=8 |
| | $I^2S$ word alignment frequency | | 8.000 | | kHz | <I2S_sample_rate>=0 |
| | | | 11.03 | | kHz | <I2S_sample_rate>=1 |
| | | | 12.00 | | kHz | <I2S_sample_rate>=2 |
| | | | 16.00 | | kHz | <I2S_sample_rate>=3 |
| | | | 22.05 | | kHz | <I2S_sample_rate>=4 |
| | | | 24.00 | | kHz | <I2S_sample_rate>=5 |
| | | | 32.00 | | kHz | <I2S_sample_rate>=6 |
| | | | 44.10 | | kHz | <I2S_sample_rate>=7 |
| | | | 48.00 | | kHz | <I2S_sample_rate>=8 |
| T4 | $I^2S$ CLK high begin to $I^2S$ WA high begin | -24 | | 32 | ns | <I2S_mode> = 0 |
| T5 | $I^2S$ CLK low end to $I^2S$ WA high end | -24 | | 32 | ns | <I2S_mode> = 0 |
| T6 | $I^2S$ TXD invalid before $I^2S$ CLK low end | | | 24 | ns | <I2S_mode> = 0 |
| T7 | $I^2S$ TXD valid after $I^2S$ CLK high begin | | | 22 | ns | <I2S_mode> = 0 |
| T8 | $I^2S$ RXD setup time before $I^2S$ CLK high end | 60 | | | ns | <I2S_mode> = 0 |
| T9 | $I^2S$ RXD hold time after $I^2S$ CLK low begin | 12 | | | ns | <I2S_mode> = 0 |

**Table 22: AC characteristics of digital audio interface in PCM mode (<I2S_mode> = 0,1) and Master mode enabled**

### PCM mode – Slave mode

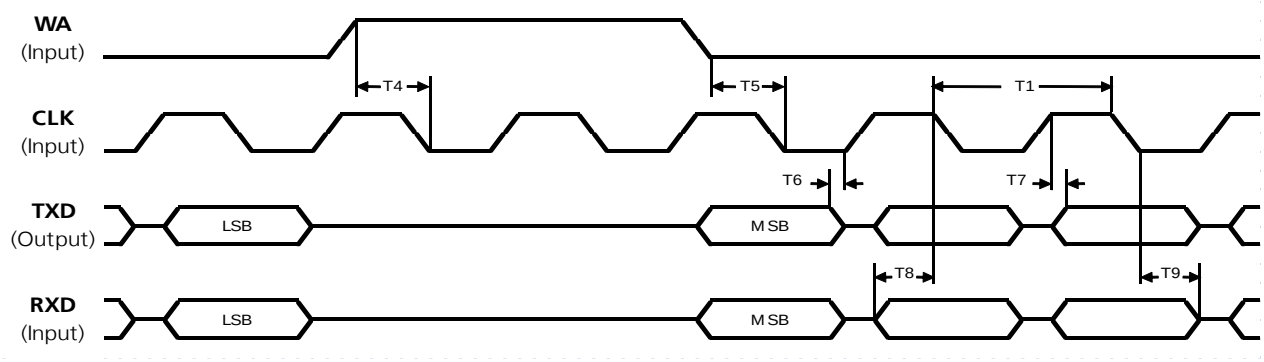


**Figure 10: AC characteristics of digital audio interface in PCM mode (<I2S_mode> = 0) and Slave mode enabled**

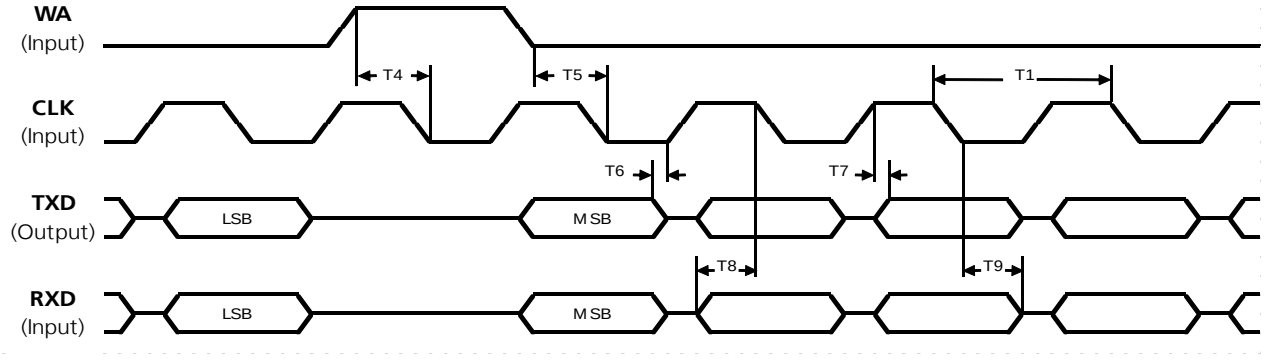


**Figure 11: AC characteristics of digital audio interface in PCM mode (<I2S_mode> = 1) and Slave mode enabled**

| Parameter | Description | Min. | Typ. | Max. | Unit | Remarks |
|---|---|---|---|---|---|---|
| T1 | $I^2S$ clock period | 6.944 | | | µs | <I2S_mode>=0, <I2S_sample_rate>=0 |
| | | 7.353 | | | µs | <I2S_mode>=1, <I2S_sample_rate>=0 |
| | | 5.039 | | | µs | <I2S_mode>=0, <I2S_sample_rate>=1 |
| | | 5.335 | | | µs | <I2S_mode>=1, <I2S_sample_rate>=1 |
| | | 4.630 | | | µs | <I2S_mode>=0, <I2S_sample_rate>=2 |
| | | 4.902 | | | µs | <I2S_mode>=1, <I2S_sample_rate>=2 |
| | | 3.472 | | | µs | <I2S_mode>=0, <I2S_sample_rate>=3 |
| | | 3.676 | | | µs | <I2S_mode>=1, <I2S_sample_rate>=3 |
| | | 2.520 | | | µs | <I2S_mode>=0, <I2S_sample_rate>=4 |
| | | 2.668 | | | µs | <I2S_mode>=1, <I2S_sample_rate>=4 |
| | | 2.315 | | | µs | <I2S_mode>=0, <I2S_sample_rate>=5 |
| | | 2.451 | | | µs | <I2S_mode>=1, <I2S_sample_rate>=5 |
| | | 1.736 | | | µs | <I2S_mode>=0, <I2S_sample_rate>=6 |
| | | 1.838 | | | µs | <I2S_mode>=1, <I2S_sample_rate>=6 |
| | | 1.260 | | | µs | <I2S_mode>=0, <I2S_sample_rate>=7 |
| | | 1.334 | | | µs | <I2S_mode>=1, <I2S_sample_rate>=7 |
| | | 1.157 | | | µs | <I2S_mode>=0, <I2S_sample_rate>=8 |
| | | 1.225 | | | µs | <I2S_mode>=1, <I2S_sample_rate>=8 |

| Parameter | Description | Min. | Typ. | Max. | Unit | Remarks |
|---|---|---|---|---|---|---|
| 1/T1 | I²S clock frequency | 144.0 | | | kHz | <I2S_mode>=0, <I2S_sample_rate>=0 |
| | | 136.0 | | | kHz | <I2S_mode>=1, <I2S_sample_rate>=0 |
| | | 198.5 | | | kHz | <I2S_mode>=0, <I2S_sample_rate>=1 |
| | | 187.4 | | | kHz | <I2S_mode>=1, <I2S_sample_rate>=1 |
| | | 216.0 | | | kHz | <I2S_mode>=0, <I2S_sample_rate>=2 |
| | | 204.0 | | | kHz | <I2S_mode>=1, <I2S_sample_rate>=2 |
| | | 288.0 | | | kHz | <I2S_mode>=0, <I2S_sample_rate>=3 |
| | | 272.0 | | | kHz | <I2S_mode>=1, <I2S_sample_rate>=3 |
| | | 396.9 | | | kHz | <I2S_mode>=0, <I2S_sample_rate>=4 |
| | | 374.9 | | | kHz | <I2S_mode>=1, <I2S_sample_rate>=4 |
| | | 432.0 | | | kHz | <I2S_mode>=0, <I2S_sample_rate>=5 |
| | | 408.0 | | | kHz | <I2S_mode>=1, <I2S_sample_rate>=5 |
| | | 576.0 | | | kHz | <I2S_mode>=0, <I2S_sample_rate>=6 |
| | | 544.0 | | | kHz | <I2S_mode>=1, <I2S_sample_rate>=6 |
| | | 793.8 | | | kHz | <I2S_mode>=0, <I2S_sample_rate>=7 |
| | | 749.7 | | | kHz | <I2S_mode>=1, <I2S_sample_rate>=7 |
| | | 864.0 | | | kHz | <I2S_mode>=0, <I2S_sample_rate>=8 |
| | | 816.0 | | | kHz | <I2S_mode>=1, <I2S_sample_rate>=8 |
| | I²S word alignment period | | 125.0 | | µs | <I2S_sample_rate>=0 |
| | | | 90.70 | | µs | <I2S_sample_rate>=1 |
| | | | 83.33 | | µs | <I2S_sample_rate>=2 |
| | | | 62.50 | | µs | <I2S_sample_rate>=3 |
| | | | 45.35 | | µs | <I2S_sample_rate>=4 |
| | | | 41.67 | | µs | <I2S_sample_rate>=5 |
| | | | 31.25 | | µs | <I2S_sample_rate>=6 |
| | | | 22.68 | | µs | <I2S_sample_rate>=7 |
| | | | 20.83 | | µs | <I2S_sample_rate>=8 |
| | I²S word alignment frequency | | 8.000 | | kHz | <I2S_sample_rate>=0 |
| | | | 11.03 | | kHz | <I2S_sample_rate>=1 |
| | | | 12.00 | | kHz | <I2S_sample_rate>=2 |
| | | | 16.00 | | kHz | <I2S_sample_rate>=3 |
| | | | 22.05 | | kHz | <I2S_sample_rate>=4 |
| | | | 24.00 | | kHz | <I2S_sample_rate>=5 |
| | | | 32.00 | | kHz | <I2S_sample_rate>=6 |
| | | | 44.10 | | kHz | <I2S_sample_rate>=7 |
| | | | 48.00 | | kHz | <I2S_sample_rate>=8 |
| T4 | I²S WA high begin before I²S CLK low begin (latching edge of I²S CLK) | 36 | | | ns | <I2S_mode> = 0 |
| T5 | I²S WA low begin before I²S CLK low begin (latching edge of I²S CLK) | 36 | | | ns | <I2S_mode> = 0 |
| T6 | I²S TXD invalid before I²S CLK rising edge (shifting edge of I²S CLK) | | | 12 | ns | <I2S_mode> = 0 |
| T7 | I²S TXD valid after I²S CLK rising edge (shifting edge of I²S CLK) | | | 79 | ns | <I2S_mode> = 0 |
| T8 | I²S RXD setup time before I²S CLK falling edge (latching edge of I²S CLK) | 22 | | | ns | <I2S_mode> = 0 |
| T9 | I²S RXD hold time after I²S CLK falling edge (latching edge of I²S CLK) | 24 | | | ns | <I2S_mode> = 0 |

**Table 23: AC characteristics of digital audio interface in PCM mode (<I2S_mode> = 0,1) and Slave mode enabled**

#### 4.2.9.2 AC characteristics of Digital Clock Output pin

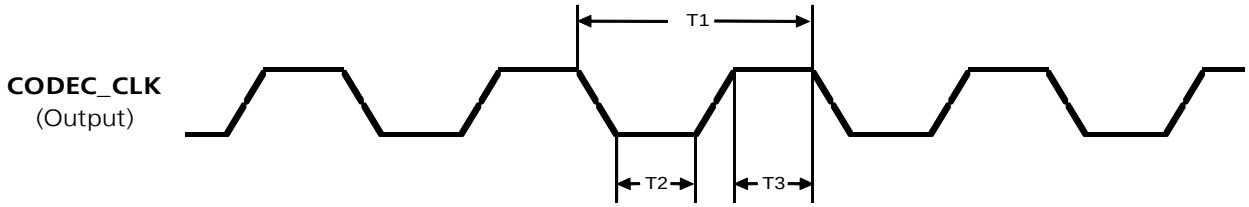


**Figure 12: AC characteristics of CODEC_CLK digital clock output**

| Parameter | Description | Min. | Typ. | Max. | Unit | Remarks |
|---|---|---|---|---|---|---|
| T1 | CODEC_CLK clock period | | 38 | | ns | CODEC_CLK output set to 26 MHz |
| | | | 77 | | ns | CODEC_CLK output set to 13 MHz |
| 1/T1 | CODEC_CLK clock frequency | | 26 | | MHz | CODEC_CLK output set to 26 MHz |
| | | | 13 | | MHz | CODEC_CLK output set to 13 MHz |
| T2 | CODEC_CLK clock low time | 10 | | | ns | CODEC_CLK output set to 26 MHz |
| | | 26 | | | ns | CODEC_CLK output set to 13 MHz |
| T3 | CODEC_CLK clock high time | 10 | | | ns | CODEC_CLK output set to 26 MHz |
| | | 26 | | | ns | CODEC_CLK output set to 13 MHz |

**Table 24: AC characteristics of CODEC_CLK digital clock output**

### 4.2.10 USB pins

USB data lines (**USB_D+** and **USB_D-**) are compliant to the USB 2.0 high-speed specification. See the Universal Serial Bus Revision 2.0 specification [16] for detailed electrical characteristics. The values in Table 25 related to USB 2.0 high-speed physical layer specifications are for information only.

| Parameter | Min. | Typ. | Max. | Unit | Remarks |
|---|---|---|---|---|---|
| USB detection voltage on pin VUSB_DET | 4.40 | 5.00 | 5.25 | V | |
| Current sink at VUSB_DET | | 30 | | µA | |
| High-speed squelch detection threshold (input differential signal amplitude) | 100 | | 150 | mV | |
| High speed disconnect detection threshold (input differential signal amplitude) | 525 | | 625 | mV | |
| High-speed data signaling input common mode voltage range | -50 | | 500 | mV | |
| High-speed idle output level | -10 | | 10 | mV | |
| High-speed data signaling output high level | 360 | | 440 | mV | |
| High-speed data signaling output low level | -10 | | 10 | mV | |
| Chirp J level (output differential voltage) | 700 | | 1100 | mV | |
| Chirp K level (output differential voltage) | -900 | | -500 | mV | |

**Table 25: USB pins characteristics**

### 4.2.11 DDC ($I^2C$) pins

DDC ($I^2C$) lines (**SCL** and **SDA**) are compliant to the $I^2C$-bus standard mode specification. See the $I^2C$-bus Specifications [13] for detailed electrical characteristics. The values in Table 26 related to $I^2C$-bus standard mode specifications are for information only.

| Parameter | Min. | Typ. | Max. | Unit | Remarks |
|---|---|---|---|---|---|
| Internal supply for DDC domain | 1.73 | 1.80 | 1.87 | V | Generic Digital Interfaces supply (V_INT) |
| L-level input | -0.20 | | 0.35 | V | |
| H-level input | 1.31 | | 1.93 | V | |
| L-level output | | 0.00 | 0.35 | V | Max value at $I_{OL}$ = +1.0 mA |
| Input/Output leakage current | | | 0.7 | µA | 0.2 V < $V_{IN}$ < 1.93 V |
| Clock frequency on SCL | | 100 | | kHz | |

**Table 26: DDC ($I^2C$) pins characteristics (DDC domain)**

# 5 Mechanical specifications

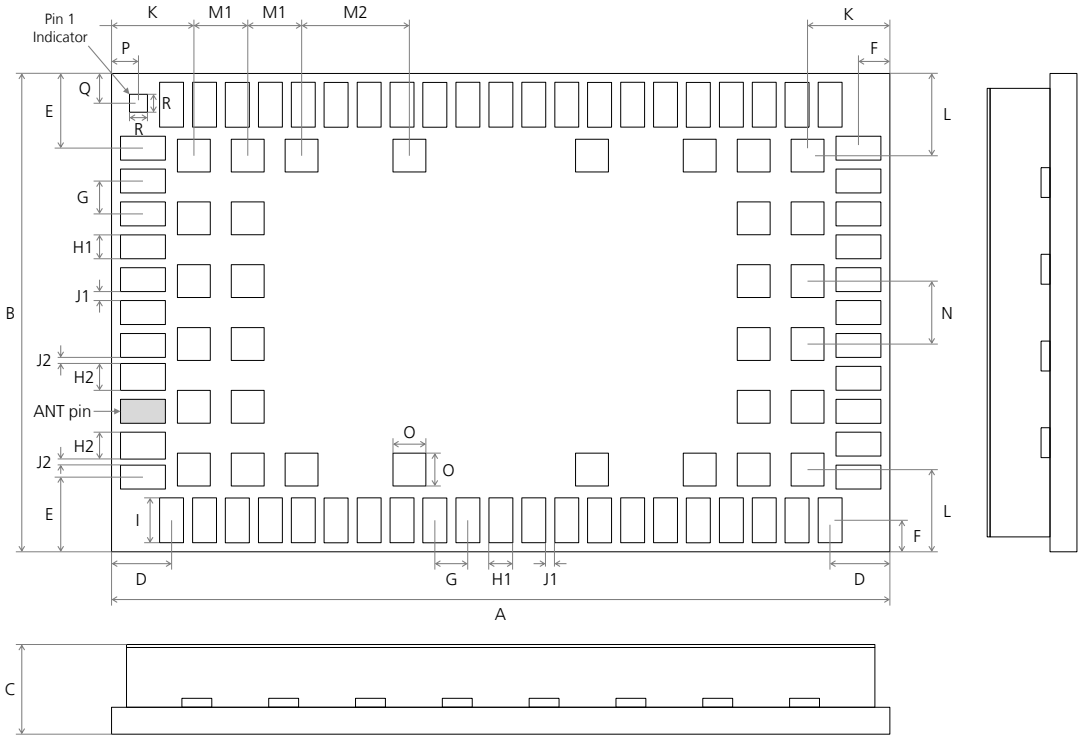


**Figure 13: SARA-U2 series dimensions (bottom and sides views)**

| Parameter | Description | Typical | | Tolerance | |
|---|---|---|---|---|---|
| A | Module Height [mm] | 26.0 | (1023.6 mil) | +0.20/-0.20 | (+7.9/-7.9 mil) |
| B | Module Width [mm] | 16.0 | (629.9 mil) | +0.20/-0.20 | (+7.9/-7.9 mil) |
| C | Module Thickness [mm] | 3.0 | (118.4 mil) | +0.25/-0.15 | (+9.8/-5.9 mil) |
| D | Horizontal Edge to Lateral Pin Pitch [mm] | 2.0 | (78.7 mil) | +0.20/-0.20 | (+7.9/-7.9 mil) |
| E | Vertical Edge to Lateral Pin Pitch [mm] | 2.5 | (98.4 mil) | +0.20/-0.20 | (+7.9/-7.9 mil) |
| F | Edge to Lateral Pin Pitch [mm] | 1.05 | (41.3 mil) | +0.20/-0.20 | (+7.9/-7.9 mil) |
| G | Lateral Pin to Pin Pitch [mm] | 1.1 | (43.3 mil) | +0.02/-0.02 | (+0.8/-0.8 mil) |
| H1 | Lateral Pin Height [mm] | 0.8 | (31.5 mil) | +0.02/-0.02 | (+0.8/-0.8 mil) |
| H2 | Lateral Pin close to ANT Height [mm] | 0.9 | (35.4 mil) | +0.02/-0.02 | (+0.8/-0.8 mil) |
| I | Lateral Pin Width [mm] | 1.5 | (59.1 mil) | +0.02/-0.02 | (+0.8/-0.8 mil) |
| J1 | Lateral Pin to Pin Distance [mm] | 0.3 | (11.8 mil) | +0.02/-0.02 | (+0.8/-0.8 mil) |
| J2 | Lateral Pin to Pin close to ANT Distance [mm] | 0.2 | (7.9 mil) | +0.02/-0.02 | (+0.8/-0.8 mil) |
| K | Horizontal Edge to Central Pin Pitch [mm] | 2.75 | (108.3 mil) | +0.20/-0.20 | (+7.9/-7.9 mil) |
| L | Vertical Edge to Central Pin Pitch [mm] | 2.75 | (108.3 mil) | +0.20/-0.20 | (+7.9/-7.9 mil) |
| M1 | Central Pin to Pin Horizontal Pitch [mm] | 1.8 | (70.9 mil) | +0.02/-0.02 | (+0.8/-0.8 mil) |
| M2 | Central Pin to Pin Horizontal Pitch [mm] | 3.6 | (141.7 mil) | +0.02/-0.02 | (+0.8/-0.8 mil) |
| N | Central Pin to Pin Vertical Pitch [mm] | 2.1 | (82.7 mil) | +0.02/-0.02 | (+0.8/-0.8 mil) |
| O | Central Pin Height and Width [mm] | 1.1 | (43.3 mil) | +0.02/-0.02 | (+0.8/-0.8 mil) |
| P | Horizontal Edge to Pin 1 Indicator Pitch [mm] | 0.9 | (35.4 mil) | +0.20/-0.20 | (+7.9/-7.9 mil) |
| Q | Vertical Edge to Pin 1 Indicator Pitch [mm] | 1.0 | (39.4 mil) | +0.20/-0.20 | (+7.9/-7.9 mil) |
| R | Pin 1 Indicator Height and Width [mm] | 0.6 | (23.6 mil) | +0.02/-0.02 | (+0.8/-0.8 mil) |
| Weight | Module Weight [g] | < 3 | | | |

**Table 27: SARA-U2 series dimensions**

For information regarding Footprint and Paste Mask see the SARA-G3 and SARA-U2 series System Integration Manual [7].

# 6 Reliability tests and approvals

## 6.1 Reliability tests

Tests for product family qualifications are according to ISO 16750 "Road vehicles - Environmental conditions and testing for electrical and electronic equipment", and appropriate standards.

## 6.2 Approvals

### 6.2.1 SARA-U2 series

Products marked with this lead-free symbol on the product label comply with the "Directive 2002/95/EC of the European Parliament and the Council on the Restriction of Use of certain Hazardous Substances in Electrical and Electronic Equipment" RoHS).

SARA-U2 modules are RoHS compliant.

No natural rubbers, hygroscopic materials, or materials containing asbestos are employed.

Table 28 lists the SARA-U2 series main approvals.

| Regulatory / Standard / Operator | SARA-U260 | SARA-U270 | SARA-U270 ATEX | SARA-U280 |
|---|---|---|---|---|
| GCF (Global Certification Forum) | | | • | |
| PTCRB (PCS Type Certification Review Board) | • | | | • |
| R&TTE (Radio & Telecommunications Terminal Equipment EU Directive)<br>Notified Body Number | | •<br>1588 | •<br>1304 | |
| CE (Conformité Européenne)<br>Notified Body Number | | •<br>1588 | •<br>1304 | |
| FCC (US Federal Communications Commission)<br>FCC identification number | •<br>XPYSARAU260 | | | •<br>XPYSARAU280 |
| IC (Industry Canada)<br>IC certification number | •<br>8595A-SARAU260 | | | •<br>8595A-SARAU280 |
| RCM (Australia Regulatory Compliance Mark) | | • | | |
| KCC (KC mark Korea) | | • | | |
| NCC (National Communications Commission Taiwan) | | • | | |
| China Type Approvals | | • | | |
| AT&T (Mobile Network Operator) | • | | | • |
| KT (Mobile Network Operator) | | • | | |
| ATEX (ATmospheric EXplosives) | | | • | |

**Table 28: SARA-U2 series main certification approvals**

☞ For all the certificates of compliancy and for the complete list of approvals (including countries' and network operators' approvals) of SARA-U2 series modules, see our website (http://www.u-blox.com/) or please contact the u-blox office or sales representative nearest you.

### 6.2.2 SARA-U270 ATEX

SARA-U270 ATEX modules are certified as components intended for use in potentially explosive atmospheres compliant to the following standards:

- IEC 60079-0: 2011
- IEC 60079-11: 2011
- IEC 60079-26: 2006

The certification number of SARA-U270 ATEX modules according to the ATEX directive 94/9/EC is:

- SIQ 15 ATEX 017 U

The certification number of SARA-U270 ATEX modules according to the IECEx conformity assessment system is:

- IECEx SIQ 15.0001U

According to the standards listed above, the SARA-U270 ATEX modules are certified with the following marking:

- Ex II 1G, Ex ia IIC/IIB

According to the marking stated above, the SARA-U270 ATEX modules are certified as electrical equipment of:

- group 'II': intended for use in areas with explosive gas atmosphere other than mines susceptible to firedamp
- category '1G': intended for use in zone 0 hazardous areas, in which explosive atmospheres caused by mixtures of air and gases, vapors or mists are present continuously, for long periods or frequently
- level of protection 'ia': intrinsically safe apparatus with very high level of protection, not capable of causing ignition in normal operation and with the application of one countable fault or a combination of any two countable fault plus those non-countable faults which give the most onerous condition
- subdivision 'IIC/IIB': intended for use in areas where the nature of the explosive gas atmosphere is considered very dangerous based on the Maximum Experimental Safe Gap or the Minimum Ignition Current ratio of the explosive gas atmosphere in which the equipment may be installed (a typical gas is hydrogen), so that the modules are also suitable for applications intended for use in subdivision IIB (typical gas is ethylene) and subdivision IIA (a typical gas is propane)

The section 4.2.1 defines the temperature range of use of SARA-U270 ATEX modules.

The RF radiating profile of SARA-U270 ATEX modules is compliant to all the applicable 3GPP / ETSI standards, with a maximum of 2 W RF pulse power (corresponding to 1.15 mJ RF pulse energy) and with a maximum average power of 250 mW according to the GSM/GPRS and WCDMA power class stated in Table 2.

The section 9.1 describes the nameplate of SARA-U270 ATEX modules (see the Figure 17).

The following maximum input and equivalent parameters must be considered in sub-division IIC:

- Ui = 3.8 V
- Ii = 1.6 A (burst)
- Pi = 3.5 W
- Ci = 132 µF
- Li = 9.8 µH

The following maximum input and equivalent parameters must be considered in sub-divisions IIB, IIA:

- Ui = 4.2 V
- Ii = 2.5 A (burst)
- Pi = 3.5 W
- Ci = 132 µF
- Li = 9.8 µH

☞ For more information about the integration of SARA-U270 ATEX modules in applications intended for use in potentially explosive atmospheres, see the SARA-G3 / SARA-U2 Series System Integration Manual [7].

# 7 Product handling & soldering

## 7.1 Packaging

SARA-U2 modules are delivered as hermetically sealed, reeled tapes to enable efficient production, production lot set-up and tear-down. For more information about packaging, see u-blox Package Information Guide [17].

**Figure 14: Reeled SARA-U2 modules**

### 7.1.1 Reels

SARA-U2 modules are deliverable in quantities of 250 pieces on a reel. SARA-U2 modules are delivered using reel Type B as described in the u-blox Package Information Guide [17].

| Parameter | Specification |
|---|---|
| Reel type | B |
| Delivery quantity | 250 |

**Table 29: Reel information for SARA-U2 modules**

☞ Quantities of less than 250 pieces are also available. Contact u-blox for more information.

### 7.1.2 Tapes

Figure 15 specifies the dimensions and orientations of the tapes for SARA-U2 series module.

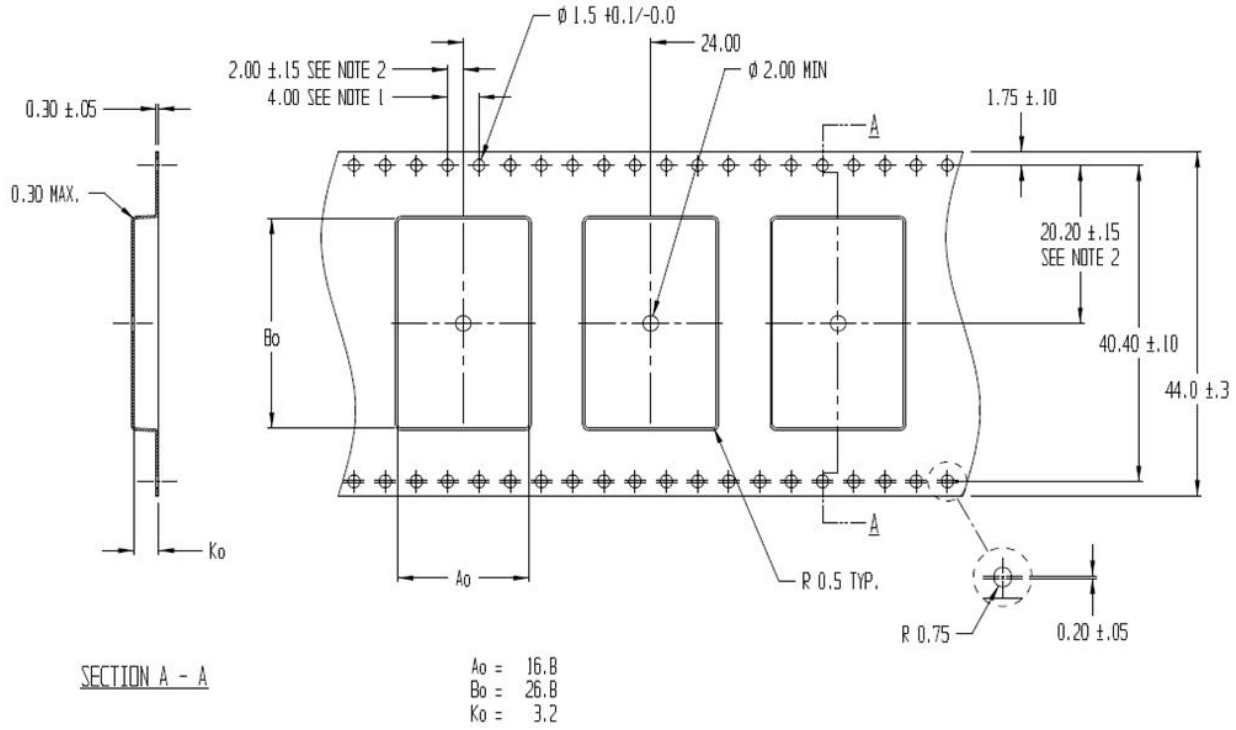


**Figure 15: SARA-U2 series tape dimensions (mm)**

| Parameter | Value |
|---|---|
| $A_0$ | 16.8 |
| $B_0$ | 26.8 |
| $K_0$ | 3.2 |

**Table 30: SARA-U2 series tape dimensions (mm)**

Note 1: 10 sprocket hole pitch cumulative tolerance ± 0.2.

Note 2: pocket position relative to sprocket hole is measured as true position of pocket, not pocket hole.

Note 3: $A_0$ and $B_0$ are calculated on a plane at a distance "R" above the bottom of the pocket.

## 7.2 Moisture Sensitivity Levels

**SARA-U2 modules are Moisture Sensitive Devices (MSD) in accordance to the IPC/JEDEC specification.**

The Moisture Sensitivity Level (MSL) relates to the packaging and handling precautions required. SARA-U2 modules are rated at MSL level 4. For more information regarding moisture sensitivity levels, labeling, storage and drying see the u-blox Package Information Guide [17].

For MSL standard see IPC/JEDEC J-STD-020 (can be downloaded from http://www.jedec.org/).

## 7.3 Reflow soldering

Reflow profiles are to be selected according to u-blox recommendations (see SARA-G3 and SARA-U2 series System Integration Manual [7]).

**Failure to observe these recommendations can result in severe damage to the device!**

## 7.4 ESD precautions

**SARA-U2 modules contain highly sensitive electronic circuitry and are Electrostatic Sensitive Devices (ESD). Handling SARA-U2 modules without proper ESD protection may destroy or damage them permanently.**

SARA-U2 modules are Electrostatic Sensitive Devices (ESD) and require special ESD precautions typically applied to ESD sensitive components.

Table 8 reports the maximum ESD ratings of the SARA-U2 module.

Proper ESD handling and packaging procedures must be applied throughout the processing, handling and operation of any application that incorporates SARA-U2 module.

ESD precautions should be implemented on the application board where the module is mounted, as described in SARA-G3 and SARA-U2 series System Integration Manual [7].

**Failure to observe these precautions can result in severe damage to the device!**

# 8 Default settings

| Interface | AT settings | Comments |
|---|---|---|
| UART interface | Enabled | Multiplexing mode can be enabled by AT+CMUX command providing following channels:<br>• Channel 0: control channel<br>• Channel 1 – 5: AT commands / data connection<br>• Channel 6: GNSS tunneling<br>• Channel 7: SAP (SIM Access Profile) |
| | AT+IPR=0 | One-shot automatic baud rate detection enabled |
| | AT+ICF=3,1 | Frame format: 8 bits, no parity, 1 stop bit<br>☞ Where AT+IPR=0 is the default value, the AT+ICF value in the profile is not applied (AT+IPR=0 overrules the AT+ICF setting) and the one-shot automatic frame detection is active. |
| | AT&K3 | HW flow control enabled |
| | AT&S1 | DSR line set ON in data mode and set OFF in command mode |
| | AT&D1 | Upon an ON-to-OFF transition of DTR, the module enters online command state and issues an OK result code |
| | AT&C1 | Circuit 109 changes in accordance with the Carrier detect status; ON if the Carrier is detected, OFF otherwise |
| USB interface | Enabled | 7 USB CDCs (Communications Device Class) by default available:<br>• USB1: AT and data<br>• USB2: AT and data<br>• USB3: AT and data<br>• USB4: GNSS tunneling<br>• USB5: Primary Log (diagnostic purpose)<br>• USB6: Secondary Log (diagnostic purpose)<br>• USB7: SAP (SIM Access Profile) |
| | AT&K3 | HW flow control enabled |
| | AT&S1 | DSR line set ON in data mode and set OFF in command mode |
| | AT&D1 | Upon an ON-to-OFF transition of DTR, the module enters online command state and issues an OK result code |
| | AT&C1 | Circuit 109 changes in accordance with the Carrier detect status; ON if the Carrier is detected, OFF otherwise |
| Power saving | AT+UPSV=0 | Disabled |
| Network registration | AT+COPS=0 | Self network registration |

**Table 31: SARA-U2 series default settings**

See the u-blox AT Commands Manual [4] and the SARA-G3 and SARA-U2 series System Integration Manual [7] for information about further settings.

# 9 Labeling and ordering information

## 9.1 Product labeling

The labels of SARA-U2 series modules include important product information as described in this section.

Figure 16 illustrates the label of all the SARA-U2 series modules except for SARA-U270 ATEX, and includes: u-blox logo, production lot, Pb-free marking, product Type Number, IMEI number, FCC and IC certification numbers (if applicable), CE marking with the Notified Body number and production country.

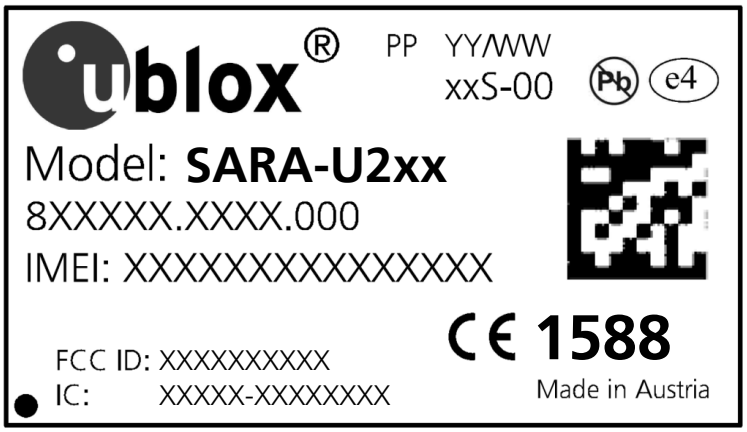


**Figure 16: SARA-U2 series modules label**

Figure 17 illustrates the label of SARA-U270 ATEX modules, and includes: u-blox logo, production lot, Pb-free marking, product Type Number, IMEI number, ATEX marking with the IECEx and ATEX certificate numbers and category classification, CE marking with the Notified Body number and production country.

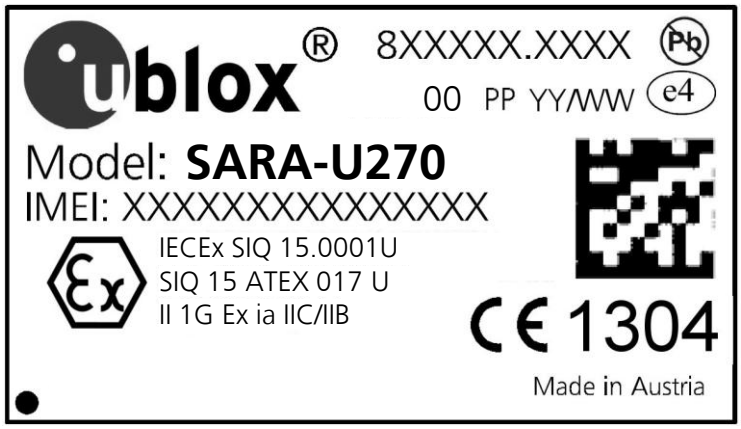


**Figure 17: SARA-U270 ATEX modules label**

☞ For information about the approval codes and for all the certificates of compliancy of SARA-U2 series modules, see our website, http://www.u-blox.com/.

## 9.2 Explanation of codes

Three different product code formats are used. The **Product Name** is used in documentation such as this data sheet and identifies all the u-blox products, independent of packaging and quality grade. The **Ordering Code** includes options and quality, while the **Type Number** includes the hardware and firmware versions. Table 32 details these 3 different formats:

| Format | Structure |
|---|---|
| **Product Name** | SARA-TGVV |
| **Ordering Code** | SARA-TGVV-TTQ |
| **Type Number** | SARA-TGVV-TTQ-XX |

**Table 32: Product code formats**

Table 33 explains the parts of the product code.

| Code | Meaning | Example |
|---|---|---|
| PPP(P) | Form factor (3 or 4 digit, typically 4 for cellular products) | SARA |
| TG | Platform (Technology and Generation)<br>• Technology: G:GSM; U: HSUPA; L:LTE, C:CDMA 1xRTT; D:EV-DO<br>• Generation: 1…9 | U2 |
| VV | Variant function set based on the same platform [00…99] | 00 |
| TT | Major product version [00…99] | 00 |
| Q | Quality grade/production site<br>• S = professional<br>• A = automotive<br>• X = ATEX | S |
| XX | Minor product version (not relevant for certification) | Default value is 00 |

**Table 33: Part identification code**

## 9.3 Ordering information

| Ordering No. | Product |
|---|---|
| SARA-U260-00S | UMTS/HSPA 850/1900 MHz and GSM/EGPRS 850/1900 MHz bands for America,<br>26.0 x 16.0 x 3.0 mm, 250 pcs/reel |
| SARA-U260-03S | UMTS/HSPA 850/1900 MHz and GSM/EGPRS 850/1900 MHz bands for America,<br>26.0 x 16.0 x 3.0 mm, 250 pcs/reel |
| SARA-U270-00S | UMTS/HSPA 900/2100 MHz and GSM/EGPRS 900/1800 MHz bands for Europe, Asia and other countries,<br>26.0 x 16.0 x 3.0 mm, 250 pcs/reel |
| SARA-U270-03S | UMTS/HSPA 900/2100 MHz and GSM/EGPRS 900/1800 MHz bands for Europe, Asia and other countries,<br>26.0 x 16.0 x 3.0 mm, 250 pcs/reel |
| SARA-U270-53S | UMTS/HSPA 900/2100 MHz and GSM/EGPRS 900/1800 MHz bands, approved by KT Korean network operator,<br>26.0 x 16.0 x 3.0 mm, 250 pcs/reel |
| SARA-U270-00X | UMTS/HSPA 900/2100 MHz and GSM/EGPRS 900/1800 MHz bands for Europe, Asia and other countries,<br>ATEX certified, 26.0 x 16.0 x 3.0 mm, 250 pcs/reel |
| SARA-U280-00S | UMTS/HSPA 850/1900 MHz bands for America,<br>26.0 x 16.0 x 3.0 mm, 250 pcs/reel |
| SARA-U280-03S | UMTS/HSPA 850/1900 MHz bands for America,<br>26.0 x 16.0 x 3.0 mm, 250 pcs/reel |

**Table 34: Product ordering codes**

# Appendix
# A Glossary

| Name | Definition |
|---|---|
| ACM | Abstract Control Model |
| ADC | Analog to Digital Converter |
| ATEX | Atmospheres Explosive |
| BER | Bit Error Rate |
| CDC | Communications Device Class |
| DDC | Display Data Channel ($I^2C$ compatible) Interface |
| DL | Down-link (Reception) |
| Driver Class | Output Driver Class: see Table 19 for definition |
| DRX | Discontinuous Reception |
| ECM | Ethernet networking Control Model |
| EDGE | Enhanced Data rates for GSM Evolution |
| ERS | External Reset Input Signal |
| GDI | Generic Digital Interfaces (V_INT supply power domain) |
| GND | Ground |
| GNSS | Global Navigation Satellite System |
| GPIO | General Purpose Input Output |
| GPRS | General Packet Radio Service |
| GSM | Global System for Mobile communications |
| H | High logic digital level |
| HSDPA | High Speed Downlink Packet Access |
| HSUPA | High Speed Uplink Packet Access |
| $I^2C$ | Inter-Integrated Circuit Interface |
| $I^2S$ | Inter-IC Sound Interface |
| L | Low logic digital level |
| LGA | Land Grid Array |
| N/A | Not Applicable |
| PCN / IN | Product Change Notification / Information Note |
| PD | Pull-Down |
| POS | Power-On Input Signal (power domain) |
| PU | Pull-Up |
| PU/PD Class | Pull-Up / Pull-Down Class: see Table 19 for definition |
| RMC | Reference Measurement Channel |
| SIM | SIM Interface (power domain) |
| SPI | Serial Peripheral Interface |
| T | Tristate (Output of the pin set to tri-state, i.e. high impedance state) |
| T/PD | Tristate with internal active Pull-Down enabled |
| T/PU | Tristate with internal active Pull-Up enabled |
| TBD | To Be Defined |
| UART | Universal Asynchronous Receiver-Transmitter serial interface |
| UL | Up-link (Transmission) |
| UMTS | Universal Mobile Telecommunications System |
| USB | Universal Serial Bus (power domain) |

**Table 35: Explanation of abbreviations and terms used**

# Related documents


[1] 3GPP TS 27.007 - AT command set for User Equipment (UE)

[2] 3GPP TS 27.005 - Use of Data Terminal Equipment - Data Circuit terminating Equipment (DTE - DCE) interface for Short Message Service (SMS) and Cell Broadcast Service (CBS)

[3] 3GPP TS 27.010 - Terminal Equipment to User Equipment (TE-UE) multiplexer protocol

[4] u-blox AT Commands Manual, Docu No UBX-13002752

[5] u-blox Android RIL Production delivery Application note, Docu No UBX-13002041

[6] u-blox Windows Embedded RIL Production delivery Application note, Docu No UBX-13002043

[7] u-blox SARA-G3 and SARA-U2 series System Integration Manual, Docu No UBX-13000995

[8] u-blox GNSS Implementation Application Note, Docu No UBX-13001849

[9] 3GPP TS 26.267 eCall Data Transfer; In-band modem solution; General description

[10] 3GPP TS44.031 Location Services (LCS); Mobile Station (MS) - Serving Mobile Location Centre (SMLC) Radio Resource LCS Protocol (RRLP)

[11] ITU-T Recommendation V24, 02-2000. List of definitions for interchange circuits between Data Terminal Equipment (DTE) and Data Connection Equipment (DCE)

[12] u-blox Mux Implementation Application Note for wireless modules, Docu No UBX-13001887

[13] $I^2C$-bus specification and user manual - Rev. 5 - 9 October 2012 - NXP Semiconductors, http://www.nxp.com/documents/user_manual/UM10204.pdf

[14] 3GPP TS 34.121-1 - User Equipment conformance specification; Radio transmission and reception (FDD); Part 1: Conformance specification

[15] 3GPP TS 51.010-1 - Mobile Station conformance specification; Part 1: Conformance specification

[16] Universal Serial Bus Revision 2.0 specification, http://www.usb.org/developers/docs/usb20_docs/

[17] u-blox Package Information Guide, Docu No UBX-14001652

[18] 3GPP TS 25.331 Radio Resource Control (RRC); Protocol specification

[19] GSMA IoT Device Connection Efficiency Guidelines


☞ For regular updates to u-blox documentation and to receive product change notifications, register on our homepage.

# Revision history

| Revision | Date | Name | Status / Comments |
|---|---|---|---|
| R01 | 22-Jan-2014 | sfal / sses | Initial release |
| R02 | 29-Apr-2014 | sses | Updated: receiver sensitivity performance, normal operating temperature range, maximum ESD ratings, USB audio device class support, GPIO configuration table. |
| R03 | 20-Jun-2014 | sses | Advance Information document status.<br>Added VCC current consumption characteristics. |
| R04 | 18-Jul-2014 | sses | Early Production Information document status.<br>Added VCC current consumption characteristics for 3G Tx/Rx connected modes. |
| R05 | 10-Apr-2015 | sfal | Extended the document applicability to SARA-U270 ATEX; removed SARA-U290 and audio over USB feature; updated list of approvals and product labeling |
| R06 | 15-May-2015 | sfal | Extended applicability to product version "03" and related features |
| R07 | 26-Jun-2015 | lpah | Advance Information document status. |
| R08 | 10-Aug-2015 | sfal | Early Production Information document status<br>Extended applicability to SARA-U270-53S |

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